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The classification of articles follows the table of contents used for the "Soil and Water Conservation Research Needs" of the Soil Conservation Service. Abstracted articles are not editorialized and the language of the author is used wherever possible. In foreign articles, the units of measure are converted to usual American units. Tables are included where they help to present the information. When the entire number of a publication is devoted to reviewing one subject then the entire publication is abstracted as one article giving title and authors of each paper included in the publication. Abbreviations of journals and addresses follow U.S.D.A. Misc. Pub. 765, July 1958.

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CONTENTS

WATERSHED ENGINEERING

Watershed Development

SEE ALSO 6, 7, 229.

1. Krammes, J. S., and Hill, L. W. "FIRST AID" FOR BURNED WATERSHEDS. U.S. Forest Serv. Res. Note PSW 29, 7 pp. 1963.

Most of the vegetative cover on the San Dimas Experimental Forest was destroyed by a wildfire in 1960. Following the fire an emergency research program was initiated to test several "first-aid" treatments aimed at reducing flood and erosion damage from burned watersheds.
Preliminary results of post-fire rehabilitation on the San Dimas Experimental forest were:

1. Perennial grasses were the least effective in reducing peak flows and debris yields.
2. Annual grasses had little effect on moderating peaks but they gave a 16 percent reduction in debris.
3. Channel stabilization structures had a lesser effect in reducing peak flows than the other physical treatments but accounted for about a 35 percent reduction in debris yields.
4. Because of steep topography, contour trenches could not be spaced closely enough to provide sufficient storage for runoff from large storms. Despite their weakness in reducing peak flows, contour trenches accounted for a 60 percent reduction in debris.
5. Contour row planting of barley was the most successful treatment for reducing both peak flows and debris yields. This treatment showed a 65 percent reduction in debris yields.

Pacific Southwest Forest and Range Expt. Sta., FS, USDA, Berkeley, Calif.

Hydrology

SEE ALSO 6, 7.

2. Rothacher, J. NET PRECIPITATION UNDER A DOUGLAS-FIR FOREST. Forest Sci. 9(4): 423-429. 1963.

Under the dense stands of old-growth Douglas-fir (Pseudotsuga menziesii (Mirb.) Franco) and associated species typical of Douglas-fir forests of western Oregon and Washington, throughfall averaged 76 percent of gross summer precipitation. Throughfall varied with storm size from near 0 percent in storms under 0.05 inch to about 82 percent in storms over 3 inches.

Density of old-growth stands, which ranged from 75 percent to 92 percent, had some influence on interception. Since estimates of density are not generally available, a relationship based on storm size was determined to be more useful.

A linear relation, which fits the data best, explained 96 percent of the variation in throughfall in summer months. Throughfall in winter months increased to an average of about 86.3 percent. A precise relationship with storm size was not determined, but in

storms producing 8 inches or more gross precipitation, throughfall was estimated to approach 96 percent. Stemflow was relatively unimportant for nearly all species. Weighted average stemflow measured in the 1959-60 water year was only slightly more than 0.27 percent of the total precipitation.

Pacific Northwest Forest and Range Expt. Sta., FS, USDA, Corvallis, Oreg.

3. Thorud, D. B. EFFECTS OF PRUNING ON RAINFALL INTERCEPTION IN A MINNESOTA RED PINE STAND. Forest Sci. 9(4): 452-455. 1963.

The effect of pruning on rainfall interception was determined by removing 50 percent of the live crown length from all Pinus resinosa Aik. trees in one of the paired plots in each of two replications. After treatment, 49 storms were measured for throughfall, only 28 of which produced measurable stemflow.

Although treatment did not significantly affect seasonal throughfall or stemflow, an increase in the former was noticeable for small storms while a decrease in the latter was characteristic for larger storms. The throughfall increase ranged from 46 percent of the gross precipitation for storms between about .01 and .04 inch, to about 7 percent (possibly not significant) for storms between .16 and .77 inch. The stemflow decrease for storms between .77 and 3.81 inches averaged about 1.5 percent of the gross precipitation. Small increases in the net precipitation of small storms probably did not significantly affect soil moisture supplies.

U. Minn., St. Paul, Minn.

4. Sartz, R. S. WATER YIELD AND SOIL LOSS FROM SOIL-BLOCK LYSIMETERS PLANTED TO SMALL TREES AND OTHER CROPS. U.S. Forest Serv. Res. Paper LS-6, 23 pp. 1963.

From 1934-42 the Lake States Forest Experiment Station operated 10 large lysimeters at the Upper Mississippi Valley Soil Conservation Experiment Station, La Crosse, Wis.

The lysimeters were 20 feet long, 10 feet wide, and 4 feet deep. They were filled with undisturbed blocks of Fayette sil plus an 8-inch layer of topsoil.

After a test period of about a year, treatments were established, and surface runoff, percolation, and soil loss were measured for 6 years. The treatments in six lysimeters were: Hardwood seedlings with leaf mulch (two lysimeters); hardwood seedlings without leaf mulch; Scotch pine seedlings with needle mulch; grass; and annual grain. Results from the four other lysimeters were not given because of faulty percolation records.

There was a strong interaction between treatment and season. Growing-season runoff from the mulched trees and grass was low compared with dormant-season runoff, whereas the reverse was true for the annual grain. The unmulched hardwoods were in between.

During the growing season, 6-year runoff averages for the mulched trees and grass ranged between 0.46 and 0.65 inch; and from the unmulched hardwoods and the grain it averaged 3.68 and 6.49 inches. Most of the runoff came from a few high-intensity storms. During the dormant season, the effect of treatment on runoff was much less pronounced.

Most of the percolation occurred during the dormant season. Only the two mulched hardwoods yielded significant amounts (an average of 2.1 inches) during the growing season. Annual variation was high in both seasons. Treatment effects on dormant-season percolation were not clear-cut.

Soil loss was very low from all the lysimeters that had a protective cover, and high from those with unmulched hardwoods and the grain. Most of this came from growing season rainstorms.

During the experiment, the trees grew from rows of small seedlings to dense stands of saplings. Although the trend was not too clear-cut, growing season runoff decreased with time on all but the annual grain lysimeter.

Percolation from the mulched trees during the growing season showed a general decrease with time.

The effect of time on soil loss from the unmulched hardwoods lysimeter was more pronounced. It dropped from 17.1 to 0.2 tons per acre in 5 years. The other lysimeters showed no change with time.

A separate analysis of individual periods of percolation showed that almost all the percolation occurred in the spring months, the result of melting snow and spring rains on wet soil. Percolate flowed for as long as 20 days without rainfall.

Analysis of the water budget showed that evapotranspiration accounted for about three-fourths of the precipitation. Total water yield from the lysimeters compared favorably with streamflow records from a nearby watershed.

Tables and graphs.

Lake States Forest Expt. Sta., FS, USDA, St. Paul, Minn.

Geology

SEE ALSO 8, 16, 18, 106, 120.

5. Bull, W. B. HISTORY AND CAUSES OF CHANNEL TRENCHING IN WESTERN FRESNO COUNTY, CALIFORNIA. Amer. J. Sci. 262: 249-258. 1964.

Most of the recent channel trenching in western Fresno County, Calif., has occurred since 1855. Reports of early settlers, maps, and field evidence indicate two periods of accelerated erosion, one from 1875-95 and the other from about 1935-45.

Many channels were deepened a total of 25 to 40 feet. During the period of erosion that started about 1935, many streams cut deeper, leaving the previous channel bottoms as terraces.

The amount and rate of stream-channel erosion were partly controlled by periods of above normal stream flow caused by large rainfall. Rainfall data from five stations in the Coast Ranges and Central Valley of California show two periods of very large annual rainfall, one from about 1875-95 and the other from about 1935-45. These periods of large annual rainfall were also periods of high frequency of large daily rainfall and about average frequency of small daily rainfall.

U.S. Geol. Survey, Dept. Int., Sacramento, Calif.

SEE ALSO 30, 110.

6. Burford, J. B., and Lillard, J. H. HIGH-ACCURACY STREAMFLOW MEASUREMENT WITH LOW-COST INSTALLATIONS. Trans. ASAE 6(4): 276-278, 281. 1963.

Existing rateable structures such as highway box-type culverts and other flow-control devices are prevalent in many areas where the need for small watershed hydrologic data is most acute. Where supplemented by proper low-flow controls, these structures can be instrumented to form accurate and reliable streamgaging stations.

The Virginia V-notch weir, properly designed and located with respect to the existing structure, constitutes a very economical and efficient low-flow control in such an installation.

More than 51 watershed years of records from the Virginia stations have demonstrated the splendid performance of these low-cost gaging stations, both from the standpoint of reliability of records and low maintenance costs.

Three runoff events were selected to show the effects of different type storms on sediment concentrations and fractional components. The runoff event of April 3, 1958, was a result of a high-intensity rainfall which caused high concentrations of fine materials. The runoff event of February 18, 1961, was a result of a uniform, low-intensity rainfall which produced low to medium velocities. Due to the low to medium velocities, the sands concentrations were lower than normal. The runoff event of February 20 to 22, 1961, followed an event that wetted the channels and watershed, and as a result of a long duration, low-intensity rainfall, produced high discharges and velocities. The low-intensity rainfall caused the concentration of fine material to be low, but the high channel velocities caused the concentrations of sands to be much higher than normal.

SWCRD, ARS, USDA, Blacksburg, Va., 24061

7. Horn, D. L., and Schwab, G. O. EVALUSTION OF RATIONAL RUNOFF COEFFICIENTS FOR SMALL AGRICULTURAL WATERSHEDS. Trans. ASAE 6(3): 195-198, 201, 233. 1963.

Improved runoff coefficients were developed for the rational method of peak runoff rate prediction. The rational formula was evaluated by using the derived coefficients and five methods of estimating time of concentration.

Runoff coefficients were derived from 11 small, single-crop watersheds at Coshocton, Ohio. Seven combinations of cover and cultural practices were represented. These runoff coefficients were a function of rainfall intensity and antecedent precipitation, but independent of watershed topography.

Peak runoff-rate frequency curves were constructed for 12 gaged watersheds in Ohio, Nebraska, Wisconsin, and Texas. These watersheds satisfied certain criteria for size, length of record, and constancy of cover conditions. Comparison of peak runoff rates obtained from these curves with those predicted by the rational formula and by Cook's method indicated that the rational method was more precise. With the rational formula, the best estimates of peak runoff rates were obtained where the time of concentration was taken as a function of the time of lag.

SCS, USDA, Hanford, Calif.

Ground Water Recharge

8. Haskell, E. E., Jr., Bianchi, W. C., and Pomeroy, C. R. LOW INTAKE RATES AND RISING PERCHED WATER TABLES HINDER GROUND WATER RECHARGE IN SOUTHWESTERN FRESNO COUNTY. Calif. Agr. 17(9): 2-3. 1963.

Farmlands of southwestern Fresno County are in great need of ground water recharge. Most irrigation pumping occurs from below a confining layer of diatomaceous clay, 500 to 700 feet below the ground surface. However, a shallow water table is perched on layers of heavy-textured sedimental soils occurring 75 to 100 feet below all the experimental locations.

Water intake rates of the soils in southwestern Fresno County are low for recharge purposes. However, extending the period of flooding will allow the movement of considerable depths of water through these profiles to a perched water table. But pumping from this shallow water table is now limited, and water table elevations are continuing to rise. This threatening water table situation, together with the poor quality of the perched water at these sites, makes the practice of surface spreading for artificial recharge undesirable.

SWCRD, ARS, USDA, Fresno, Calif., 93726

WATER MANAGEMENT

Irrigation

SEE ALSO 8, 34, 40, 70, 86, 88, 97, 106, 109, 113, 119, 120, 169, 205, 212, 219.

9. Jensen, M. E., and Haise, H. R. ESTIMATING EVAPOTRANSPIRATION FOR VARIOUS CROPS USING SOLAR RADIATION. Sprinkler Irrig. Assoc. 1962 Open Tech. Conf. Proc. 14-29. 1962.

Measured evapotranspiration data from various irrigated areas in the Western United States obtained during the past 35 years were collected, screened and preliminary analysis were completed. An example of the results obtained was presented. Preliminary analysis indicates that improved estimates of evapotranspiration (E_t) rates for 5-day periods and longer can be made using the simplified energy balance equation. Variables in the equation that are not evaluated independently include reflectance, thermal radiation, sensible heat flux in the air, and other minor heat exchanges. The main parameters used in this equation are solar radiation and percent of the crop growing season.

SWCRD, ARS, USDA, Twin Fall, Idaho, 83301

10. Lord, W. J., Michelson, L. F., and Field, D. L. RESPONSE TO IRRIGATION AND SOIL MOISTURE USE BY MCINTOSH APPLE TREES IN MASSACHUSETTS. Mass. Expt. Sta. B. 537, 23 pp. 1963.

Investigations were conducted from 1956-62 to determine the moisture use of McIntosh apple trees and their need for irrigation in Massachusetts.

During the 1956, 1957, and 1962 seasons, rainfall was below normal and considerable soil moisture depletion occurred. One orchard was irrigated in 1957, and 1962 but a fruit growth response was obtained only in 1957.

The growth rate of fruit was reduced when the percentage of available moisture in the top 40 inch soil depth under the dripline of the trees was still above the permanent wilting percentage. The zone of greatest root concentration was found to be nearer the tree trunk and some of the roots may have been in soil at permanent wilting percentage when the growth rate of fruit was reduced.

Fruit size and color was increased on the irrigated trees. The irrigated fruit were more mature and many were too large and had considerable water core at harvest. When moisture shortage occurs prior to mid-July, flower bud formation appears to be increased. Irrigated and non-irrigated fruit of similar size did not differ in flesh firmness. At the end of storage, non-irrigated fruit had more scald than those from irrigated trees.

Soils moisture levels under adjacent trees and under individual trees varied markedly from point to point. The pattern of moisture extraction as determined by a concentric placement of plaster of Paris blocks from the tree trunk to beyond the dripline indicated a moisture absorption gradient decreasing outward from the trunk.

The problem of obtaining a reliable determination of soil moisture levels in apple orchards and the practicability of irrigating McIntosh orchards in Massachusetts were discussed.

Expt. Sta., Col. Agr., U. Mass., Amherst, Mass.

11. Gray, A. S. THE SOLID-SET AS RELATED TO IRRIGATION, HEAT CONTROL, FROST CONTROL. Sprinkler Irrig. Assoc. 1963 Open Tech. Conf. Proc.: 83-90. 1963.

The expanded use of the solid-set concept of sprinker irrigation systems is following a pattern similar to the early use of standard portable irrigation equipment. The pioneering use of sprinklers for agriculture was primarily for moisture-sensitive, high-cash value crops. In 1946, there were approximately 400,000 acres of sprinkler irrigation equipment used in the United States. More than 5 million acres of agricultural crop land is now under sprinkler irrigation. Every crop grown commercially in the United States (with the exception of rice) is sprinkled.

The pioneering use of the solid-set was for similar crops but did not get started till about 1956. Because of the general acceptance today of sprinkler irrigation as one of the major keys to high profit agriculture, the solid-set concept has spread more rapidly in these few years than did the early attempts of "portable" sprinkler systems. Today there are thousands of acres under solid-set systems in fruit and nut orchards, potatoes, strawberries, pole beans, shade tobacco, all types of nurseries, and other moisture-sensitive crops.

The design of solid-set systems is basically no different from a standard portable system except that the solid-set has a sprinkler lateral in position throughout the season at each move-location of a portable lateral. There are the following basic types of solid-set systems:

1. Semi permanent--aluminum laterals are usually used with quick couplers similar to a standard portable system. Laterals are laid with the rows for easy cultivation, or in some cases such as potatoes, the laterals are laid out after the last cultivation and remain in place until just prior to harvest when they are removed.

2. Permanent--both the mainlines and laterals for this system are buried. Standard underground pipe of plastic, steel, or asbestos-cement are used. Generally speaking, the permanent system is used only where there is an established perennial crop pattern such as grapes, orchards etc.

The lateral lines for a solid-set system can be:

1. Operated manually with standard portable or permenent valves.
2. Operated automatically by means of hydraulic or electrically actuated valves on the mainline controlled by pre-set time switches or similar devices.
3. Designed with sprinklers with control valves in each riser which are cycled automatically by a timing device. The first sprinkers on each lateral line operate simultaneously, then the second on each line and so forth, until the last sprinkler on each lateral has finished its cycle. The cycling then reverts back to the first sprinkler on each line. Under such a system, only one sprinkler operates on each lateral line at one time.

With a single capital investment in a solid-set system, the user gets multiple value by using it for several key functions of good overall crop management: (1) Irrigation; (2) fertilizer and chemical injection; and (3) crop protection from excesses of temperature--high heat and frost.

Natl. Rain Bird Sales & Engin. Crop.

12. Nourse, E. F., Hills, F. J., Henderson, D. W., and Loomis, R. S. SUPPLEMENTAL IRRIGATION BY SPRINKLING INCREASES DELTA SUGAR BEET YIELDS. Calif. Agr. 17(7): 2-3. 1963.

Sugar beets in some areas of the Sacramento Delta are commonly irrigated by maintaining a water table 3 to 4 feet below the soil surface. Crops usually exhaust the available water in the top 2 feet of soil by early summer. For the balance of the season, plants obtain most of their water and mineral nutrients from a narrow zone of soil, 1 foot or less above the water table. Under these conditions, sugar beet plants frequently wilt during warm summer afternoons and often suffer a severe loss of leaves.

Use of sprinklers to supplement the usual sub-irrigation method of irrigation increased October-harvested sugar beet production by 8.4 tons per acre. In addition to alleviating drought conditions, sprinkling increased the plant uptake of nitrogen and phosphorus from this highly organic soil.

Farm Advisor, Solano Co., San Diego, Calif.

13. Reinecke, E. THE MECHANICS OF FERTILIZING THROUGH A SPRINKLER IRRIGATION SYSTEM. Irrig. Engin. and Maintenance 14(1): 10-11. 1964.

A discussion of the mechanics of fertilizing through a sprinkler irrigation system was given for the engineer installing the system. The corrosive action of the materials injected must be considered. Backflow prevention units must be installed to prevent backflow of the chemicals into domestic water supplies or streams.

Febco Inc., Sun Valley, Calif.

14. Moore, C. V. VALUE OF STORING STREAM RUNOFF FOR IRRIGATION USE. Natural Resource J. 3(1): 98-102. 1963.

How linear programming can be used to arrive at estimates of the value of water stored for irrigation use was shown. By moving a block of the unimpeded flow of a stream through time to more nearly coincide with the peak demand period for crops, the result was to change significantly the optimum cropping program and to increase farm income.

The increase in farm income represents the value arising from storing this water. Knowledge of this relationship can be related to optimum reservoir capacity, and lend more objectivity to dam design and water resource development.

FPED, ERS, USDA, Davis, Calif.

15. Jacobs, H. S. IRRIGATION WATER QUALITY CHARTS FOR KANSAS. Kans. Arg. Expt. Sta. Tech. B. 133, 16 pp. 1963.

Regression equations relating the maximum exchangeable Na percentage or maximum electrical conductivity in any soil horizon to constituents in irrigation water and mean soil saturation percentage were obtained.

Gapon's equation was the basis for predicting exchangeable Na percentage. The regression equations were utilized in conjunction with calculated confidence limits to construct irrigation water quality charts. Since probability relationships were incorporated into the charts, a measure of the reliability of each estimation of water quality was given.

Criteria used in constructing the charts included soluble Na percentage of the water, electrical conductivity of the water, and mean soil saturation percentage.

Predictions of salt and Na accumulation levels based on data reported should be restricted to soils and conditions similar to those studied.

Charts.

Agr. Expt. Sta., Kans. State U., Manhattan, Kans.

16. Longenecker, D. E. FAR-WEST TEXAS IRRIGATION WATERS CONTAIN NITROGEN. Tex. Agr. Prog. 9(5): 12. 1963.

Studies of ground waters used for irrigation in the Pecos, Balmorhea, Fort Stockton, Coyanosa, and Pecos River areas of Texas showed that many of these waters contain appreciable quantities of nitrate.

Presence of nitrates in the irrigation waters means that savings in the amount of nitrogen applied could be made. Farmers fortunate enough to have nitrate-containing waters can save part or all of their annual fertilizer costs.

Many farmers inadvertently may be applying too much nitrogen to cotton as recommendations for these areas call for 100 to 150 pounds of nitrogen per acre per year for cotton. Additional nitrogen usually reduces yields by causing excessive vegetative growth at the expense of fruiting. It also can cause a delay in fruiting when combined with more frequent irrigation.

The amounts of nitrate in the waters of these areas vary considerably without a definite trend. Nitrate contents range from zero to several hundred p.p.m. Waters containing both high and low nitrate are being pumped from various depths in all of these areas. Only

10 p.p.m. nitrate means that 30 pounds of nitrogen per acre are being applied with total water application of 5 feet per acre.

All farmers in the areas mentioned should have pump waters tested for nitrate content at least once each year, and they should alter their fertilizer rates in accordance with the recommendations given following these tests.

Tex. Agr. Expt. Sta., Substation No. 17, El Paso, Tex.

17. Raney, F. RICE WATER TEMPERATURE. Calif. Agr. 17(9): 6-7. 1963.

Low irrigation water temperatures have begun to reach problem proportions in the production of certain crops in northern California and may become far more common, especially in the northern parts of the State.

When Shasta Dam was completed in 1945, the temperature of the Sacramento River below the dam changed suddenly from 61^{o} to 45^{o} F. During the same year, river water temperatures fell 5 degrees at Sacramento, 260 river miles below the dam. Immediately, rice growers found that as much as 5 percent of their planted acreage did not mature in time for harvesting at the end of the available crop season of 160 days. Irrigation water taken from the river more than 100 miles below the dam had become too cold for satisfactory rice growth. Growers farthest from the river water diversion point and those using well waters or warmer surface waters, were seldom affected. Some of the partial solutions proposed for maintaining irrigation water temperatures for rice above critical minimum thresholds include:

1. Skimming warmer surface water from the reservoir for release into stream channels is one approach. The U.S. Bureau of Reclamation is incorporating a surface water skimming tower in the design of Whiskeytown Dam on Clear Creek near Redding in response to the needs of wildlife downstream.
2. Providing an afterbay with sufficient area to permit the water to warm before use may be feasible. (The proposed Oroville afterbay of 23,000 acres will warm the water only 3 to 8 degrees at the required flow rates.)
3. Broad, shallow canals as a joint water conveyance and water-warming facility are being used in Japan.
4. In certain instances other sources of energy such as electricity, waste heat from atomic fission reactors, or heat from deep-earth hydrogen fusion reactors may be available.

U. Calif., Davis, Calif.

18. Myers, V. I. WATER CONSERVATION RESEARCH FOR LIMITED IRRIGATION WATER SUPPLIES. Proc. 17th Ann. Nevada Water Conference pp. 3-13, 1963.

Water conservation research results indicate there are many opportunities for conserving and using irrigation water supplies more efficiently. Some of these are: (1) Improving prediction and use of precipitation; (2) utilizing soil moisture more efficiently; (3) reducing evaporation and transpiration; (4) improving irrigation efficiencies; (5) fertilizing to make more efficient use of water; (6) reclaiming saline soils; (7) using low quality water; (8) using water from high water tables; and (9) modifying soil profiles for improved water intake, storage, and plant root development. As competition for our water

resources increases, we will need to explore and develop new avenues for conserving the remaining supply.

SWCRD, ARS, USDA, Weslaco, Tex., 78596

19. Brown, L. N. PLANTING AND IRRIGATION ON THE CONTOUR. Calif. Agr. Expt. Sta. Ext. Serv. C. 523, 24 pp. 1963.

Information was given on the following: (1) How plants, soil, and water depend on each other; (2) why contour irrigation is practical, even on steep slopes; and (3) how to lay out a contour planting, particularly one designed for a small acreage. Complete information on laying out contour plantings under difficult conditions was not given.

Planting and irrigation on the contour enables a person to:

1. Use steep slopes otherwise unsuitable for irrigation--irrigating on the contour allows water to flow slowly in furrows that cross the slope on gentle grades.
2. Avoid serious soil erosion--since the furrow grade is calculated according to the texture of the soil, the danger of furrow erosion is minimized.
3. Use irrigation water more efficiently--since irrigation water runs deep on gentle furrow grades, its percolation into the soil is much greater than that of shallower water running in steep, straight furrows.

Calif. Agr. Expt. Sta. Ext. Serv., Berkeley, Calif.

20. Yamada, H., Miller, J., and Stockton, J. DESICCATED GRASS MULCH INCREASES IRRIGATION EFFICIENCY FOR COTTON. Calif. Agr. 17(11): 12-13. 1963.

The use of dry grass mulch in cotton furrows substantially increased irrigation efficiency at Shafter, Calif. The millet and sudangrass was seeded in 8-inch bands down the furrows and then desiccated by oil-spraying when growth reached 10 to 18 inches high. Time required for irrigation water to flow down the furrows was nearly doubled by the sudangrass mulch. Infiltration rates were substantially increased by the grass mulches and a greater soil water content, following irrigation, was obtained. While cotton seed yields showed no significant differences in these tests, data indicated that both crop uniformity and yield improvements could result from use of grass mulches on soils with low infiltration rates.

U. Calif., Westside Field Sta., Five Points, Calif.

21. Longenecker, D. E., Thaxton, E. L., Jr., and Lyerly, P. J. COTTON PRODUCTION IN FAR WEST TEXAS WITH EMPHASIS ON IRRIGATION AND FERTILIZATION. Tex. Agr. Expt. Sta. B. 1001, 24 pp. 1963.

Eleven separate fertility-irrigation tests with Acala 1517 cotton were conducted on major Trans-Pecos soil types during the 4-year period, 1959-62. The effect of irrigation frequency and soil fertility level on many aspects of cotton production were determined, including yields, skiprow production, earliness, boll weight, seed weight, lint weight, lint

percent, fiber quality, water use efficiency, and disease incidence. Both irrigation frequency and fertility level had significant effects on many of the above aspects and characteristics.

More frequent summer irrigation (oftener than every 14 days) had highly diverse effects on yields at various locations. This was attributed to soil type and texture, irrigation design, soil physical conditions, depth of rooting, disease incidence, or other factors.

Fertility requirements of Acala 1517 cotton were relatively independent of irrigation frequency except on sandy soils where leaching losses were serious. Maximum yields in all tests were obtained with 120 to 180 pounds of applied nitrogen per acre. Higher rates generally decreased yields slightly. Phosphate additions at low to optimum nitrogen rates had little or no effect on yields in most tests.

Skip-row planting on productive soils presents possibilities of greatly increased yields per planted acre in the El Paso Valley.

Crop maturity was greatly delayed by more frequent irrigation. Heavier nitrogen rates, combined with frequent irrigation, had an additional delaying effect. Nitrogen applications with less frequent irrigation appeared to prolong the fruiting season rather than to cause actual delays in maturity. Less frequent irrigation in late summer greatly speeded maturity in one test, but losses in yield resulted.

More frequent irrigations generally resulted in heavier bolls, heavier seed, and slightly more lint per boll, with decreases in line percent and sometimes fewer bolls per plant. Nitrogen increased boll and seed weights but had little effect on weight of lint per boll. Phosphate with frequent irrigations greatly increased seed weight.

Fiber properties (length, strength, and fineness) were only slightly affected directly by irrigation frequency or fertility level, but were adversely affected indirectly by prolonged fruiting and delays in maturity attributable to frequent irrigation and fertilization. Later-maturing bolls were smaller, had lower lint percentage, and slightly shorter fiber of definitely poorer quality.

Water use efficiency (pounds of lint per inch of applied water) was greatly reduced by more frequent irrigation in all tests.

Incidence of verticillium wilt was greatly increased by more frequent irrigation plus heavy nitrogen applications on soils of the El Paso Valley.

No immediate need was found for application of potassium or trace minerals to cotton on any of the soils of the Trans-Pecos area.

Tex. A&M U., Tex. Agr. Expt. Sta., College Station, Tex.

22. Parks, W. L., Nichols, B. C., Davis, R. L., Chapman, E. J., and Felts, J. H. RESPONSE OF BURLEY TOBACCO TO IRRIGATION AND NITROGEN. Tenn. Agr. Expt. Sta. B. 368, 19 pp. 1963.

Irrigation of burley tobacco in the Central Basin area of Tennessee should increase tobacco yields as a significant increase was obtained in 4 of the 5 years the experiments were conducted. Rainfall during the period was somewhat above normal and irrigation over time should result in yield increases greater than those obtained.

At the Tobacco Experiment Station in the East Tennessee Valley, irrigation might be a questionable practice. This is because during the 7 years, 2 years gave a significant response to irrigation, 2 years gave a significant decrease to irrigation, and in 3 of the years no significant difference was found between the irrigated and nonirrigated treatments.

Yield increases with the higher nitrogen application were generally greater in the irrigated treatments than in the unirrigated treatments. However, no consistently significant interaction between irrigation and nitrogen was observed.

U. Tenn., Agr. Expt. Sta., Knoxville, Tenn.

23. Herpich, R. L. IRRIGATING SOYBEANS. Kans. Agr. Ext. Serv. Land Reclaim. 12, 4 pp. 1963.

To insure the most profitable production from irrigated soybeans, it was necessary that all agronomic and irrigation practices be controlled at the optimum. The agronomic practices most affecting yields were: (1) Variety; (2) planting rate; (3) row spacing; and (4) tillage.

Adequate soil moisture was essential to the production of optimum yields. To insure optimum soil moisture for the crop, particular attention had to be given to the soil moisture supply at the following stages in the soybean life cycle: (1) Germination and seedling stage; (2) early bloom stage; and (3) late bloom stage.

To meet the moisture demands of the crop the following should be done: (1) Preirrigate--fill the root zone before planting the crop; and (2) keep the soil moisture reservoir about one-half full during the early bloom through late bloom stage of the plant's growth.

Ext. Serv., Kans. State U., Manhattan, Kans.

24. Andrew, R. H., and Groskopp, M. D. SWEET CORN CULTURAL STUDIES ON LOAMY SAND UNDER SUPPLEMENTAL IRRIGATION. Wis. Agr. Expt. Sta. Res. Rpt. 13, 11 pp. 1963.

Three sweet corn hybrids of the same relative maturity (W900, W909, and Foremost) were grown at Hancock, Wis., on Plainfield ls with and without irrigation in 1958-62. Irrigation averaged 6 inches per year. Plant populations were 14,500 and 29,000, with plants 12 and 6 inches apart, respectively, in 36 inch rows. Plots received broadcast and starter fertilizer, based on soil tests, plus 100 (F_1) or 300 (F_2) pounds per acre of ammonium nitrate sidedress in June.

Irrigation was necessary for dependable sweet corn production. Unirrigated plots were near failures in 3 out of the 5 years, producing 4.64 tons per acre of snapped corn, 3.30 tons of usable husked corn, and 10,929 prime ears. Irrigated plots produced 8.03 tons, 5.82 tons, and 18,553 ears respectively.

Under irrigation, 29,000 plants per acre spaced 6 inches apart in 36 inch rows gave somewhat higher yields at both nitrogen levels than did 14,500 plants. For the non-irrigated plots, production of snapped, husked, and prime ears was significantly lower at the higher populations for both the F_1 and F_2 nitrogen levels. The high population of 29,000 plants per acre was not justified, even under irrigation and at the high nitrogen level.

Under irrigation production of snapped and usable husked corn, the number of prime ears was significantly higher at the higher nitrogen level for both populations. In the non-irrigated plots production averaged slightly lower at the high nitrogen level.

Average performance of the three hybrids was approximately the same on a basis of snapped and usable husked weight.

Agr. Expt. Sta., U. Wis., Madison, Wis.

25. Pope, A. FERTILIZING IRRIGATED WHEAT ON THE HIGH PLAINS OF TEXAS. Tex. Agr. Expt. Sta. Misc. P. 688, 8 pp. 1963.

Forty-five fertilizer trials were conducted on irrigated wheat on the Northern High Plains of Texas during 1957-61. Most of these trials were located on clay loam sites with a few being located on fine sandy loams.

The limiting plant nutrients for wheat production on High Plains soils were nitrogen and phosphorus. Nitrogen was the first limiting nutrient; when nitrogen was applied in adequate amounts, phosphorus then became the limiting factor in most of the fine sandy loams and in some of the clay loams. Soils on which wheat was grown were high in available potassium.

The rates of nitrogen and phosphorus necessary for optimum yields depended on past fertilizer and cropping history, inherent fertility of the soil, and irrigation management. Soil test results, complete information on past fertilizer and cropping history, irrigation management, and results of several years' response data from several years of fertility trials were essential for reliable and economical fertilizer recommendations.

The data was used to correlate soil test results with the response of irrigated wheat to added fertilizers.

The response of wheat to various sources of nitrogen showed no measurable difference when the nitrogen materials were applied properly and at equal rates of elemental nitrogen.

Protein content of both forage and grain can be maintained at optimum levels with the use of adequate amounts of fertilizer. A sound fertilizer program will insure higher yields of forage with higher protein content. Adequate amounts of fertilizer were necessary to maintain high grain yields when wheat was grazed heavily.

Tex. A&M U., Tex. Agr. Expt. Sta., College Station, Tex.

26. Townsend, C. E. PERFORMANCE OF RED CLOVER VARIETIES UNDER IRRIGATION IN THE HIGH ALTITUDE MEADOWS OF COLORADO. Colo. Agr. Expt. Sta. B. 515 S, 13 pp. 1963.

Fifty-five red clover varieties were grown under irrigation in high altitude meadows near Hayden, Gunnison, and Fairplay, Colo. These sites are approximately 6,300 feet, 7,700 feet, and 9,500 feet above sea level, and have a growing season of approximately 90, 70, and 50 frost-free days, respectively. Persistence and disease reactions of varieties were observed for 3 harvest years and flowering dates were studied for 2 harvest years.

Marked differences were found among varieties in their persisting ability. Location had considerable effect on persistence, which was best at Hayden and poorest at Gunnison. The double-cut varieties (early-flowering types) persisted well only at Hayden. Several single-cut varieties (late-flowering types) had good persistence at all locations. Others had good persistence at two locations or at only one location. No common association was found between date of flowering and persistence. Selection for persistence in single-cut types should be done at elevations of 7,500 feet and above.

Striking differences were observed among varieties in date of flowering. Location as well as variation between years at each location influenced time of flowering.

Powdery mildew was the most serious foliage disease observed; it was present every year at Hayden but inconsequential at the other locations. Lakeland was the only resistant variety. Some virus diseases were observed at Hayden.

Some of the naturalized Swedish varieties performed well in the high altitude areas of Colorado (37° to 41° north latitude). These varieties should provide excellent germ plasm for persistence and perhaps other characters in a red clover improvement program for the high altitude irrigated meadows of the Western United States.

Agr. Expt. Sta., Colo. State U., Fort Collins, Colo.

27. Carreker, J. R., and Cobb, C., Jr. IRRIGATION IN THE PIEDMONT. Ga. Agr. Expt. Sta. Tech. B. N.S. 29, 65 pp. 1963.

Irrigation research conducted at the University of Georgia and the Southern Piedmont Conservation Experiment Station from 1946-58 was reported.

Short droughts occurred in Georgia several times each year. Rainless periods sometimes extended to 4 and even to 6 weeks' duration. When these droughts coincided with periods of peak moisture demand by crops, the crops often suffered and yields were reduced.

There is an abundant supply of water available for irrigation in Georgia, but it is largely undeveloped. Streams and farm ponds are the principal sources of supply in the northern half of the state.

Tomatoes responded favorably to irrigation on upland Cecil soil during 1950-53, with an average annual yield of 21,875 and 11,794 pounds per acre with and without irrigation, respectively. Irrigated tomatoes generally were better in quality than those grown without extra water.

The average yield of pole beans was 6,678 and 3,262 pounds per acre with and without irrigation. The irrigated beans were far superior in quality to those grown with rainfall only.

Yields of sweet corn were improved with irrigation for plantings where dry weather coincided with ear formation. Plantings that were not subjected to drought showed no benefit from extra water. Average yields from 12 plantings in three years were 959 and 780 dozen ears, and 3.56 and 2.87 tons per acre, for irrigated and unirrigated corn, respectively.

Irrigation of sweet potatoes gave little, if any, benefit during 1950-52. With less rainfall in 1953, the yield was doubled with irrigation. Irrigation had practically no effect on the grade of sweet potatoes.

Field corn yields during 1946-54 ranged from 10.6 to 109.1, with an average of 62.2 bushels per acre, without irrigation. Where extra water was applied the range was from 51.3 to 120.6 for an average of 85.0 bushels per acre.

Yields of well-fertilized cotton that was not irrigated ranged from 742 to 2,383 pounds per acre during 1951-57. With irrigation, the yields ranged from 1,731 to 3,621 pounds per acre. Soil moisture records in 1955-57 showed that during June-August, cotton used 2 to 4 inches of moisture previously stored in the soil, 6 to 8 inches of rainfall, and 4 to 15 inches of irrigation water. Optimum yields were obtained with a total water use of 15 to 18 inches from all sources. The most efficient use of irrigation was obtained by refilling the top 2 feet of the root zone when 30 percent or less of the available moisture remained in this zone. Irrigated cotton produced heavier seed, more lint, slightly longer fiber, and a little finer fiber, as contrasted to cotton subjected to a moisture stress during droughts.

A 2-acre pasture of Dallisgrass-Ladino clover on Congaree soil was irrigated and a similar area left unirrigated. Both areas were grazed by half-grown dairytype heifers in 1947-51. The average annual production per acre was 385 animal days grazing and 403 pounds gain with irrigation and 277 animal days grazing and 325 pounds gain without irrigation.

Measures of roots at different soil depths under cotton, corn, tomatoes, fescue grass, and pasture sod showed all these crops to have most of their roots in the upper foot of soil. More than 80 percent of the moisture used during the growing season was drawn from the top 2 feet.

The average daily rate of evapotranspiration from cotton varied from 1 year to the next for any given level of soil moisture and between levels of soil moisture in any 1 year. The average daily rates measured in the June-August main growing and fruiting period ranged from 0.173 to 0.256 inch per day for all irrigation treatments during the 1952-57

period. The average for all irrigation treatments all years was 0.20 inch per day, and 0.13 inch per day without irrigation. Limited data for corn, tomatoes, and pole beans indicate the average daily rates from these crops with irrigation was about 0.22, 0.18, and 0.19 inch per day, respectively.

Ga. Agr. Expt. Sta., U. Ga. Col. Agr., Athens, Ga.

28. Davan, C. F., Jr., and Anderson, R. L. ECONOMIC ANALYSIS OF PHOSPHATE FERTILIZER ON IRRIGATED ALFALFA IN NORTHEASTERN COLORADO. Colo. Agr. Expt. Sta. Tech. B. 80, 13 pp. 1963.

An economic analysis of the response of alfalfa hay yields to different rates of phosphate in experiments on irrigated land in northeastern Colorado was presented. The analysis was based on a 3-year average yield. These experimental yield data were used to illustrate methods of analysis and determination of most profitable rates of fertilizer application.

The increase in alfalfa hay yield resulting from additional 50-pound applications of phosphate (available P_2O_5) decreased as the total amount of fertilizer applied increased. The experimental work was not carried to the maximum yield point.

No single rate of application of phosphate to alfalfa hay was most profitable under all conditions. Two hundred seventy pounds per acre was most profitable when hay was $10 per ton and available P_2O_5 was 9 cents per pound applied. But 450 pounds per acre was most profitable when hay was $30 per ton and available P_2O_5 was 7 cents per pound.

Table.-- Estimated annual returns from irrigated alfalfa with various rates of applications of phosphate, Terry clay loam and Weld loam soils, northeastern Colorado, 1959-61

(1) Total amount of phosphate applied (once in 3 years)	(2) Estimated annual total hay yield per acre	(3) Estimated increase in annual yields per acre	(4) Value of increase in annual yield per acre[1]	(5) Annual cost of phosphate per 50-pound unit[2]	(6) Profit on last unit of phosphate	(7) Total annual profit from phosphate
Pounds	Tons	Tons	Dollars	Dollars	Dollars	Dollars
0	2.20	---	---	---	---	---
50	3.52	1.32	26.40	1.50	24.90	24.90
100	4.14	0.62	12.40	1.50	10.90	35.80
150	4.51	0.37	7.40	1.50	5.90	41.70
200	4.79	0.28	5.60	1.50	4.10	45.80
250	4.98	0.19	3.80	1.50	2.30	48.10
300	5.10	0.12	2.40	1.50	.90	49.00
350	5.20	0.10	2.00	1.50	.50	49.50
400	5.26	0.06	1.20	1.50	-.30	49.20
450	5.30	0.04	0.80	1.50	-.70	48.50

[1] Alfalfa hay valued at $20 per ton before harvest.

[2] Costs of available P_2O_5 computed at 9 cents per pound. In this report alfalfa is fertilized only at seeding time; therefore, the total cost of the 50-pound increment of P_2O_5 must be divided by the number of years alfalfa is in the rotation, in this case 3 years ($4.50 ÷ 3).

Agr. Expt. Sta., Colo. State U., Ft. Collins, Colo.

771-426 O-65—2

SEE ALSO 169, 194.

29. Choate, R. E. UNDERGROUND DRAINAGE OF FLATWOOD SOILS. Fla. Res. Rpt. 8(4): 11. 1963.

Considerable research has been conducted on ways to minimize siltation in drain tile. The spacing at the tile joints should be correlated to the soil type. For sandy soil the individual tile should be laid and turned to avoid excessive cracks at the joints and then fitted close together. For clay soil, a 1/8 inch joint was recommended. The slope gradient should not be less than 1 percent.

The tile joint should be surrounded by a good filter material to suppress the movement of soil particles into the tile. Various filter materials have been used in field installations, such as asphalt felt, plastic, sawdust, gravel, grass, and fiberglass. A good filter material must not only exclude the movement of soil particles into the tile, but it must also permit an adequate flow of water through the tile joint.

Studies of the effectiveness of sawdust, fiberglass, gravel, and asphalt felt when used as filters in a flatwood soil, indicated that a 6-inch band of sawdust around the joint was the most effective filter. It not only gave the lowest amount of siltation but also gave the highest rate of water flow into the tile. The order of preference of the other materials was fiberglass, gravel, and asphalt felt.

Those planning tile drainage systems should make provisions for: (1) Adequate slope in the tile lines; (2) proper joint spacing according to the soil type; and (3) the use of a good filter around the tile joint. A system well-planned and properly installed will give good service for many years.

Fla. Agr. Expt. Sta., U. Fla., Gainesville, Fla.

30. Taylor, G. S., and Luthin, J. N. THE USE OF ELECTRONIC COMPUTERS TO SOLVE SUBSURFACE DRAINAGE PROBLEMS. Hilgardia 34(12): 543-558. 1963.

The numerical solution of Laplace's equation by electronic-computer analysis was illustrated for ponded flow in stratified soil. A computer program to solve for the hydraulic-head potential $\emptyset$ was presented in detail with the aid of a flow chart. The procedure followed in the program was essentially that reported by Luthin and Gaskell (1950). The primary difference is that a high-speed electronic computer was used instead of a desk calculator. The computer analysis was stopped when the residuals were reduced to a specified value. Finite-difference formulas were given for solving the Laplace equation for the following four cases: Square meshes; rectangular meshes; change from square to rectangular meshes; and square meshes containing a curvilinear surface (that is, a circular drain section). The formulas apply to both homogeneous and stratified soils.

Precision was evaluated for a particular mesh size by comparing the potentials at zero residual to those at some finite value of residual. Precision increased nearly linearly with a reduction in the residual. However, computer running time, and thus the cost of these analyses, increased nearly logarithmically with a reduction in residuals. For analyses which required large computer running times, some cost savings were made by obtaining the potentials for relatively large residuals and then graphically evaluating the potentials at zero residual by extrapolation.

The accuracy of the computer data was evaluated by comparing experimental drain flow rates with those calculated from the exact analytic solutions of Kirkham. Accuracy increased nearly linearly with a reduction in mesh size, and the deviation of computer results from calculated ones ranges between 1 and 2 percent. Computer running time also increased with a reduction in mesh size, and some compromise was uaually made between accuracy and cost.

For a prescribed precision, the use of an overrelaxation constant W materially reduced the computer running time. A technique was presented for deciding on the magnitude of W, and a table of W values was given for a square region. The feasibility of expanding the mesh size in regions where small changes in potential occur was shown.

Usefulness of the computer program was illustrated by solutions obtained for ponded flow into drains in a stratified soil. The potential use of computers in other subsurface drainage problems was discussed, and a proposal was made for obtaining computer solutions of the falling-water-table case in tile drainage. The role of the researcher in computer usage was also discussed.

Agr. Pub., University Hall, U. Calif., Berkeley 4, Calif.

31. Watts, D. G., and Luthin, J. N. TESTS OF THICK FIBERGLASS FILTERS FOR SUBSURFACE DRAINS. Hilgardia 35(3): 33-45. 1963.

A series of tests was made to evaluate the use of thick fiberglass materials as a substitute for gravel filters around subsurface drains and to study the effect of perforation spacing on inflow to filtered drain pipe. Measurements of the thickness of several materials when placed under compressive loads in the range of 2 to 10 p.s.i. were given. This is within the range of pressures that might be expected under field conditions. The hydraulic conductivity in a longitudinal direction through these materials was determined for various states of compressive loading to indicate whether or not water could move freely to an opening in a drain pipe once it entered the filter material.

For the perforation spacing studies, both filtered and nonfiltered drains were installed in a large steel tank. Under ponded conditions the flow from these drains was measured for several arrangements of perforations in the drains. For the nonfiltered drain, theoretical and measured flows were compared to obtain an indication of the uniformity of soil packing around the drain.

From the results of the experiments and studies of background information, the authors concluded that:

1. Within the range of loading ordinarily expected under field conditions, the thickness of the fiberglass filter materials tested was greatly reduced from that measured in the uncompressed state. This change in thickness depended on; (1) Initial thickness; (2) initial density; and (3) to some extent, manufacturing processes.
2. The hydraulic conductivity of the fiberglass materials was high and essentially varied little with load or samples of different thicknesses and densities. All "K" values measured were within the range given by other workers for clean sands or mixtures of clean sands and gravels.
3. For ponded water conditions, inflow to a filtered drain was greater than that to a nonfiltered drain with a similar perforation arrangement. Inflow to the filtered drain was affected very little by perforation spacing, whereas inflow to the nonfiltered drain varied considerably. Experimental results were influenced by a time effect not related to perforation spacing.

Agr. Pub., University Hall, U. Calif., Berkeley 4, Calif.

32. Cotner, M. L., and Schmid, A. A. DRAIN LAW FOR MICHIGAN LANDOWNERS. Coop. Ext. Serv. Ext. B. E-382 Farm Sci. Ser., 16 pp. 1963.

The most relevant parts of the Michigan Drain Code and the applicable common law of drainage was summarized in non-technical language.

Part I contains a discussion on property rights and responsibilities (common law rules).

Part II contains a discussion on group organization for drainage. A table was included which summarized the legal procedures for establishing new drainage districts and improving existing drains. Other sections of the Michigan Drain Code were discussed.

Part III contains a discussion on some of the financial and technical assistance available for drainage improvements.

Coop. Ext. Serv., Mich. State U., East Lansing, Mich.

33. Drablos, C. J. W. AGRICULTURAL AND HIGHWAY DRAINAGE LAWS. Ill. Res. 5(3): 12-13. 1963.

A few fundamental principles embodied in the laws relating to agricultural and highway drainage in Illinois were given.

Drainage law is determined by two sets of rules--common and statutory. Common law has developed through long-time usage and custom, independently of any legislative action. The principles of common law are embodied in court decisions. Common law provides a large and important segment of drainage law because it applies to adjoining areas with enough difference in elevation to cause natural drainage.

Each drainage problem must be individually analyzed so that it may be compared with similar problems that have been brought before the courts. This requires a detailed study of the present situation and a thorough knowledge of previous court actions. For legal solutions to drainage problems, therefore, it is generally necessary to obtain assistance from competent attorneys familiar with drainage law.

U. Ill., Col. Agr., Urbana, Ill.

Storage and Conveyance

SEE ALSO 14, 17, 294.

34. Boving, P. A. FARM PONDS. U. Ill., Col. Agr., Coop. Ext. Serv. C. 872. 23 pp. 1963.

Farm ponds can be an asset to any farmstead in the midwest. Ponds may be a useful source of water supply for the farmhouse, for livestock watering, dairy sanitation, rural fire protection, and irrigation. The same pond may be used for less utilitarian purposes such as swimming, fishing, boating, and winter sports. Farm ponds also have an important role to play in soil and water conservation, and are used to reduce the flood flow from a watershed by controlling runoff and erosion.

Information on farm pond construction, pond uses, and assistance for the pond project was given along with a list of selected reference reading material.

U. Ill., Col. Agr. Coop. Ext. Serv., Urbana, Ill.

Soil Physics

SEE ALSO 4, 9, 18, 27, 60, 63, 64, 68, 70, 109, 113, 114, 118, 120.

35. Boekel, P. THE EFFECT OF ORGANIC MATTER ON THE STRUCTURE OF CLAY SOILS. Netherland J. Agr. Sci. 11: 250-263. 1963.

The effect of organic-matter content on intrinsic and actual soil structure was studied. Figures relating to the intrinsic soil structure were obtained by determining the lower plastic limit, the upper plastic limit, and the moisture percentage at pF = 2 (field capacity). The actual soil structure was determined by measuring the pore space and air content and by visual estimation.

The effect of organic manuring on the actual soil structure was studied with town refuse, farmyard manure, green manuring, and ley farming. An increase in organic-matter content decreased the slaking sensitivity of silt soils, increased the resistance to plastic deformation caused by the mechanical forces acting on heavy clay soils under wet conditions, and improved the actual soil structure. Concerning the latter effect, the visual estimation increases with 0.6--0.7 points per percent organic matter, but varied somewhat according to the nature of the organic matter.

The organic-matter content required to prevent slaking was determined to give a good resistance to mechanical structure deterioration and to provide an actual soil structure conducive to plant growth. In order to obtain a soil structure suitable for good plant growth, the lowest organic-matter percentage was required on a clay soil in which the percentage of particles $< 16\ \mu$ ranged from 15 to 30, depending on the soil treatment.

Inst. Soil Fertility, Groningen, Netherlands.

36. Babcock, K. L. THEORY OF CHEMICAL PROPERTIES OF SOIL COLLOIDAL SYSTEMS AT EQUILIBRIUM. Hilgardia 34(11): 417-542. 1963.

The theories of model soil colloids were developed. The principal point of departure was thermodynamics. The following sections were given: (1) A consistent system of chemical thermodynamics and pertinent related physical chemistry was presented; (2) the Donnan theory and some consequences of it which may have relevance for soil systems was given and electrochemical measurements were discussed; (3) the Gouy theory of the electrical double layer was reviewed and the theory was used to calculate ionic activities; (4) ion-exchange equations based on various models were developed and the significance of different models for soil systems was analyzed in relation to the available data; and (5) a discussion was presented of the thermodynamics of soil moisture with emphasis placed on the development of theory. No effort was made to make historical or literature surveys.

Agr. Pub., University Hall, Berkeley 4, Calif.

37. Peck, E. L., and Pfankuch, D. J. EVAPORATION RATES IN MOUNTAINOUS TERRAIN. Internatl. Union Geodesy Geophys. 13th Gen. Assembly Proc. 1962. 7: 267-278. 1963.

Evaporation rates in mountainous terrain are being investigated with a specially designed network of 13 Weather Bureau "Class A" evaporation stations at elevations ranging

from 4,400 to 9,000 feet in the Wasatch Mountains near Farmington, Utah. Effects of elevation, topography, and exposure on evaporation rates are being determined.

Measurements during the first summer consisted of daily readings at all stations and simultaneous hourly readings from sunrise to sunset for the base station and each other station on an alternating basis. Analyses of the data were presented, including comparison of evaporation rates from the different stations, for pairs of stations near the same elevation with different exposures, as well as comparison of daytime and nighttime evaporation rates. The effect of drainage winds on nighttime evaporation rates was noted.

Water Supply Forecast Unit, Weather Bur., U.S. Dept. Com., Salt Lake City, Utah.

38. Fritschen, L. J., and van Bavel, C. H. M. EVAPORATION FROM SHALLOW WATER AND RELATED MICROMETEOROLOGICAL PARAMETERS. J. Appl. Met. 2(3): 407-411. 1963.

During the spring of 1961, experiments were conducted at Tempe, Ariz., to measure the magnitude of evaporation and related micrometeorological factors from isolated shallow water and an extended shallow water.

The data obtained were analyzed using the energy balance (0) equation.

$$R_n + S + W + LE + A = 0,$$

where R_n is the measured net radiation, S is the measured soil heat flux below the water layer, W is the calculated change in heat storage of the water layer, LE is evaporative flux determined from sensitive weighing lysimeters, and A is the sensible heat flux to the air obtained from the solution of the energy balance equation. The following conclusions were made:

1. A greater evaporative flux was measured from isolated shallow water than from an extended shallow water.
2. For similar radiation inputs, larger evaporative fluxes were associated with increased wind speed.
3. A continuous evaporative flux was recorded during the nocturnal hours.
4. Energy was derived from the air during the nocturnal hours for the isolated shallow water, whereas energy was given off by the extended shallow water.
5. Energy was derived from the underlying surface during the nocturnal hours.
6. The daily totals of the sensible heat flux to the air term (A) indicated that energy was derived from the air for the isolated shallow water and energy was used to heat the air in the case of the extended shallow water.

U.S. Water Conserv. Lab., SWCRD, ARS, USDA, Tempe, Ariz., 85281

39. Anderson, H. W., West, A. J., Ziemer, R. R., and Adams, F. R. EVAPORATIVE LOSS FROM SOIL, NATIVE VEGETATION, AND SNOW AS AFFECTED BY HEXADECANOL. Internatl. Union Geodesy Geophys. 13th Gen. Assembly. Proc. 1962. 7: 7-12. 1963.

First and second year effects of hexadecanol applied to soil, forest floor, and brush foliage indicated: (1) Significant reduction in evapotranspiration from bulldozed brush field the first year and smaller reductions the second year; (2) small increases in water use by brush the first year and small reductions the second year; and (3) generally no reductions of

summer evapotranspiration of forest stands or from bare soil either the first or second year after application of hexadecanol at rates of 35 to 135 pounds per acre. In a special case, a marked reduction occurred when 680 pounds per acre was applied to the soil of a forest stand and snow was added.

Marked reductions in daily evaporation from snow were brought about by applications of 12 pounds per acre of hexadecanol to snow surfaces. Reductions ranged from as little as 13 percent in a dense forest stand to as much as 70 percent in open areas.

Pacific Southwest Forest and Range Expt. Sta., FS, USDA, Berkeley, Calif.

Soil Chemistry and Mineralogy

SEE ALSO 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 60, 61, 62, 63, 64, 83, 85, 104, 217, 275, 296, 297.

40. Horikawa, Y., and Kawaguchi, K. STUDIES ON THE POTASSIUM-ADSORPTION CAUSED BY SOIL-REDUCTION: I. THE OCCURRENCE OF THE DIFFERENTIAL POTASSIUM-ADSORPTION UNDER SUBMERGENCE. Soil Sci. and Plant Nutr. 9: 181-188. 1963.

The status of K in intensively-cultivated water-logged paddy soils in which 1:1 lattice type clay mineral like halloysite was predominant was studied.

The occurrence of the differential K-adsorption against water-extraction under submergence was verified.

An increasing adsorption of K under submergence was directly attributable to the phenomenon of soil reduction revealed by the increase in soil pH.

It was strongly suggested that this reaction was promoted in part by an increase of phosphate originated from iron phosphates in soils. The adsorption of K in paddy soils under reductive condition was not associated solely with the specific nature of 2:1 clay minerals, but also with the dynamic status of other chemical soil-constituents.

Kyoto U., Kyoto, Japan.

41. Horikawa, Y., and Kawaguchi, K. STUDIES ON THE POTASSIUM-ADSORPTION CAUSED BY SOIL-REDUCTION: II. POSSIBLE MECHANISMS OF DIFFERENTIAL POTASSIUM-ADSORPTION AND RELATION TO THE AGRONOMICAL SIGNIFICANCE. Soil Sci. and Plant Nutr. 9: 189-194. 1963.

Some fundamental experiments were conducted in an attempt to clarify the mechanisms of differential K-adsorption caused by soil-reduction and to discuss the practical significance of this phenomenon with special reference to additional dressing of potassium.

It was strongly suggested that the differential adsorption was largely ascribed to the non-biological factors under the reductive soil-condition produced by microbes rather than to the K-uptake by microorganisms *per se*.

Conversion of soluble K to insoluble, referred to as differential K-adsorption in water-logged paddy soils, was explained by the mechanism of chemical sorption *via* the formation of insoluble K-containing phosphates, and by the physicochemical properties of soil colloids including amorphous sesquioxides.

Inhibition of K-uptake by rice plants under reductive-soil-condition will be intensified by the differential adsorption of K by the soil *via* the above mechanisms.

Kyoto U., Kyoto, Japan.

42. Peterson, F. J., Sturgis, M. B., and Miears, R. J. RESPONSE OF RICE TO FERTILIZER PHOSPHORUS AND POTASSIUM AS RELATED TO LEVELS OF AVAILABLE PHOSPHORUS AND POTASSIUM IN SOILS OF SOUTHWEST LOUISIANA. La. Agr. Expt. Sta. B. 569, 16 pp. 1963.

Several soil analysis-rice response relationships were studied to establish the relationships graphically that will make possible the most accurate prediction from soil analysis of whether rice will respond efficiently to the application of fertilizer phosphorus and potassium.

It was believed that extracting soil phosphorus with 0.1 N HCl + 0.03 N NH_4F at a soil to extracting solution ratio of 1:40 was a method of extracting an amount of phosphorus from the soil that closely approaches the quantity utilized by a rice crop. However, the 1:20 soil to extracting solution ratio is more convenient and has been adopted by the LSU Soil Testing Laboratory.

A significant linear relationship was established between exchangeable and available potassium. Since available potassium is easier to determine in the laboratory, it was considered the most practical index. If a soil from southwest Louisiana contains less than approximately 70 p.p.m. of available potassium a favorable increase in rice yield can be expected from the application of fertilizer potassium 84 percent of the time.

La. State U. and Agr. and Mech. Col., Agr. Expt. Sta., Baton Rouge, La.

43. Sommerfeldt, T. G., and Peterson, H. B. EFFECT OF ANIONS ON AMOUNT OF SODIUM ADSORBED BY SODIUM-SATURATED UTAH BENTONITE. Soil Sci. Soc. Amer. Proc. 27: 641-644. 1963.

Sodium-saturated Utah bentonite was equilibrated in various concentrations and kinds of sodium salt solutions to ascertain the effects of different anions in the system on the amount of sodium adsorbed by the clay. Effects of pH on the adsorption of sodium were also studied by equilibrating the clay in solutions having pH's of 7.2 and 10.5. The solutions were analyzed before and after equilibration to determine their changes in ion concentrations and pH. Soluble silicon was determined in both the equilibrate and the cation extraction solutions.

The clay proved sensitive to its anion environment. The amount of sodium adsorbed by the clay and the concentration of the soluble silicon in the equilibrate varied with the anion present. Increased concentration of anion generally increased the anion effect. After equilibration in solutions having an ionic strength of 1.0, the amount of sodium adsorbed was 66, 68, 76, 77, 94, and 115 me. per 100 g. of clay when the anions were bromide, iodide, chloride, sulfate, bicarbonate, and hydroxide, respectively. A correlation existed between the final pH and the amount of sodium adsorbed; generally the amount adsorbed increased with pH. A correlation also was evident between the amount of soluble silicon and final pH.

U. Idaho, Branch Expt. Sta., Aberdeen, Idaho.

44. Leggett, G. E., and Moodie, C. D. THE RELEASE OF FIXED AMMONIUM FROM SOILS BY SODIUM AS AFFECTED BY SMALL AMOUNTS OF POTASSIUM OR AMMONIUM. Soil Sci. Soc. Amer. Proc. 27: 645-648. 1963.

The release of fixed NH_4 from soils by Na was studied. When no K was added to NH_4-saturated air-dried soils, 86 to 98 percent of the fixed NH_4 was released during the alkaline aeration or distillation. When small amounts of K were added to the alkalizing agents, the

release was markedly decreased. When the K/Na ratio of the alkalizing agents was increased to 0.005, only 14 to 35 percent of the fixed NH_4 was released. Similar effects were noted when small amounts of NH_4 were allowed to accumulate in the system during equilibration of NH_4-saturated soils in various volumes and concentrations of NaCl solutions.

The rate of release of fixed NH_4 was studied by aerating NH_4-saturated soils in the presence of Na_2CO_3 solution. The release was slow, even under conditions which favored removal of the released NH_4 from the system. A linear relationship was obtained when the logarithm of rate of release was plotted against time. It was concluded that the release of fixed NH_4 was similar to the release of fixed K from vermiculite and the later stages of K release from biotite noted by others.

SWCRD, ARS, USDA, Prosser, Wash., 99350

45. Rowell, D. L. EFFECT OF ELECTROLYTE CONCENTRATION ON THE SWELLING OF ORIENTATED AGGREGATES OF MONTMORILLONITE. Soil Sci. 96: 368-374. 1963.

The uptake of solution by orientated montmorillonite aggregates when in equilibrium with ambient solutions was measured by weight. Single-ion systems of Na, K, NH_4, Ca, and Mg, and the mixed-ion system of Na and Ca were studied. Plate spacings could not be calculated from these measurements, for large amounts of solution appear to be held enmeshed in a gel structure in the swollen clays.

Na-montmorillonite aggregates swelled to a homogeneous gel, but aggregates of K and NH_4 montmorillonite contained many small unswollen sections, suggesting that much of the swelling takes place between nonswelling crystals in a way similar to that of illite clays. Ca-saturated aggregates take up equal amounts of solution in M solution and in distilled water, which indicates that a stable nonswelling system exists over this range of concentrations.

The uptake of solution by mixed Na-Ca montmorillonite depended on its activity ratio $\left(\frac{a\ Na}{\sqrt{a\ Ca}} \right)$ and on the total electrolyte concentration where activity was a. As the activity ratio was decreased, the proportion of the aggregate that remained unswollen increased. This effect may be due to small local differences in Ca content and orientation in the dry aggregate, which may give rise to swollen and unswollen sections in the swollen aggregate.

Soil Sci. Lab., Dept. Agr., Oxford, England.

Soil Biology

SEE ALSO 44, 82, 83.

46. McCalla, T. M., Guenzi, W. D., and Norstadt, F. A. MICROBIAL STUDIES OF PHYTOTOXIC SUBSTANCES IN THE STUBBLE-MULCH SYSTEM. Zeitschrift für Allgemeine Mikrobiologie, Akademie-Verlag, Berlin 3(3): 202-210. 1963.

Stubble-mulch farming was found to be a very effective soil and water conservation practice. However, yield reductions frequently occurred, when compared to plowing. When yield reductions occurred, the plants, particularly corn, were smaller and often showed chlorotic symptoms resembling nitrogen deficiency.

The following factors may be involved in these yield reductions with stubble mulching as compared to plowing: (1) The soil temperature of a stubble-mulched soil was lower; (2) nitrate production in the spring and early summer was generally about 5 to 10 percent less; (3) weeds such as downy brome were a more serious problem; and (4) the farmer used the tillage equipment improperly.

Other factors may also be involved in yield reductions. In 1945, studies at Lincoln, Neb., were initiated to determine if plant residues contained substances toxic to plants and if microorganisms also produced these substances. Paper, column, and gas chromatography and infrared techniques were used to study the phytotoxic substances in residues, soil, and produced by microorganisms. Determinations were made of the effect of water-soluble and ethanol-soluble materials from eight common plant residues on the growth of corn, wheat, and sorghum seedlings in aqueous solution and on wheat in soil. Organic solvents and pyrophosphate solution were used for extracting phytotoxic substances from the soil. The microbial production of phytotoxic substances was surveyed, using random isolates of fungi from stubble-mulch plots. The phytotoxic product (patulin) from a P. urticae culture was isolated and identified.

Plant residues contain, and microorganisms produce, a variety of organic substances that influence plant growth. Also, phytotoxic substances were isolated from the soil. The exact role of these phytoxic substances in the field is yet to be ascertained. However, it seems possible that under special conditions, such as in wet, cool springs, with a heavy layer of mulch at the surface of the soil, some microorganisms may gain sufficient ascendancy to produce some of these organic substances in concentrations that may affect plant growth.

SWCRD, ARS, USDA, Lincoln, Nebr., 68503

Soil-Plant-Animal Relationships

SEE ALSO 25, 86, 89, 92, 97, 119, 124, 126, 127, 129, 180, 270, 275, 277, 282.

47. Hacskaylo, J. INORGANIC DEFICIENCY SYMPTOMS IN WHITE PINE (PINUS STROBUS L.) Zemljiste I Biljka 11(1-3): 415-428. 1962.

White pine seedlings were grown from seed under greenhouse conditions.

The plants were subjected to the following inorganic culture solutions; exchange water (XX-H_2O) complete, -N, -P, -K, -Ca, -Mg, -S, -Fe, -Cu, -Zn, -B, -Zn, and -Mo.

Visual deficiency symptoms were described of the leaves, stem, and root.

Growth was expressed as the total amount of wet and dry weight produced, and the total height and diameter of each series of plants.

The water requirement was relatively higher in some of the deficiency series as compared to the complete series.

Ohio Agr. Expt. Sta., Wooster, Ohio.

48. Wear, J. I. MINOR ELEMENTS FOR PLANTS IN ALABAMA SOILS. Highlights Agr. Res. 10(2): 13. 1963.

Boron deficiencies of alfalfa, cotton, clovers, apples, and truck crops are prevalent on sandy Coastal Plain soils and on Sand Mountain soils. The available boron from these soils was about one-half as much as that in soils of the Black Belt and Limestone Valley regions.

Zinc content of soils from the Coastal Plain, Clay Hills, and Sand Mountain areas was lower than that of the other regions. Zinc deficiency of pecans is prevalent in the Coastal Plain and Clay Hill areas, and zinc deficiency of corn frequently occurs in these and the Sand Mountain areas when the pH of the soil is 6.0 and above.

Manganese contents of Alabama soils are high compared with that of soils in North and South Carolina and Florida. When soils of this region have low pH values (about 5.0), manganese toxicity of cotton may occur. This abnormality is called crinkle leaf and can be prevented or corrected by applying lime.

Certain crops are iron deficient on lime soils of the Black Belt, and some ornamentals may suffer from iron deficiency on lime or neutral soils.

Zinc deficiency of corn appears as white to yellow streaks in the leaves and white to yellow bud when plants are 6 to 12 in. high. Yields may be increased 5 to 10 bu. per acre with an application of 10 lb. per acre of zinc sulfate in the starter fertilizer. Zinc deficiency of pecans appears as a rosette and dieback of shoots in the top of the tree. Generally it is prevented by applications of 2 to 3 lb. of zinc sulfate per tree per year or corrected by an application of $\frac{1}{2}$ to 1 lb. of zinc sulfate for each year of the tree's age using a maximum of 10 to 15 lb. per tree.

Boron has been recommended for alfalfa, clovers, and certain vegetables for many years. It is now recommended for cotton on coarse-textured soils. Tests conducted for 3 years at the Sand Mountain Substation have shown an increase from boron of about 150 lb. per acre of seed cotton. Tests conducted at 21 locations in the State (mainly on farmers' fields) showed an average increase of 51 lb. per acre. The increase of 51 lb. of seed cotton is worth about $6 per acre for a 25¢ investment. Three-tenths to a half lb. of boron per acre is recommended.

Comparative Average Amounts of Boron and Zinc Available for Plants by Soil Regions in Alabama

Soil regions	Boron ppm	Zinc ppm
Limestone Valleys	0.17	0.72
Black Belt	.18	.82
Coastal Plain	.09	.48
Sand Mountain	.09	.47
Piedmont	.11	.56
Clay Hill	.13	.42

Ala. Agr. Expt. Sta., Auburn U., Auburn, Ala.

49. Hanway, J. J., Herrick, J. B., Willrich, T. L., Bennett, P. C., and McCall, J. T. THE NITRATE PROBLEM. Iowa Coop. Ext. Serv. Agr. and Home Econ. Sp. Rpt. 34, 20 pp. 1963.

Nitrate poisoning is an old problem that has been recognized by livestock producers and the medical profession for at least 100 years. However, the danger of nitrate poisoning has become more important in recent years. Greater use of commercial nitrogen fertilizers, increased production and use of nitrate-accumulating feeds,

improved feeding practices, improper sewage disposal, water contaminated by animal wastes, and the existence of diseases with similar symptoms have all added to the complexity of the problem.

Although the condition is commonly referred to as nitrate poisoning, toxicity is primarily due to nitrite, a chemically reduced form of nitrate. Nitrites may be formed from nitrates before ingestion by animals or within the digestive tract of the animal after nitrate is consumed. The nitrite, and to some extent the nitrate, is absorbed in the blood of the animal where it is combined with the hemoglobin, making it impossible for the hemoglobin to carry oxygen. If enough hemoglobin is tied up, the animal dies of suffocation.

Small amounts of nitrates are found in most plants and ground water. Under some conditions nitrates accumulate in these materials to toxic levels. Nitrates in well water have resulted in sickness and even death of animals and humans. Most of the early investigations indicated that nitrate toxicity in livestock was due largely to the ingestion of oat hay or cornstalks containing nitrates. However, corn silage, sorgo silage, grass and alfalfa-hay and pasture, certain weeds, and contaminated water have now been implicated in nitrate poisoning of animals.

Poisonous gases produced in a silo by the reduction of nitrates present in the ensiled material can cause sickness or death of animals and people in or near the silo. During the first few weeks after forages are put in a silo, nitrates in the forages are reduced to nitrogen oxides and escape as gases that are very toxic. These gases may be trapped in the silage and released later when the silo is opened.

The following methods of prevention and control of nitrate poisoning were given:

1. Have feed and/or water supplies analyzed for nitrates when conditions favorable for high nitrate content are suspected.
2. Consult your physician, veterinarian, or county extension director if you suspect that nitrates may be a problem.
3. If toxic amounts of nitrates are found in the water supply: (1) Obtain water from another source; or (2) reconstruct the well and remove the nitrate source to prevent further contamination. Nitrates can be removed from water by ion exchange, but the process is expensive.
4. Watch for signs of fuming silos, and protect humans and livestock from toxic gases. Always turn on the blower, leaving the distributor pipe close to the silage level, for at least 30 minutes before entering a silo. Do not enter the silo if you have noticed an irritating odor in the area. Fence off the silo to prevent children and animals from entering the area.
5. Test forages that may be suspected of containing excess nitrate before they are fed or put in a silo. If a high nitrate content is detected, wait until the nitrate content decreases to a safe level before grazing or harvesting the forage.
6. Preserved forages with sublethal nitrate contents may be mixed with other low-nitrate feeds, fed with high-energy diets, and fortified with vitamin A to alleviate some of the unfavorable effects.

Iowa State U. Sci. and Tech., Coop. Ext. Serv. Agr. and Home Econ., Ames, Iowa.

50. Kolp, B. J., Eppson, H. F., Richardson, L. R., Smith, C. E., and Gul, A. NITRATE CONTENT IN OATS. Wyo. Agr. Expt. Sta. B. 409, 12 pp. 1963.

Oat hay and straw is often used for feed in Wyoming. The crop fits well into a rotation, can be used as an emergency hay crop, and is easily handled.

Oats under certain conditions may accumulate large amounts of potassium nitrate, which can be toxic to livestock. This toxicity is generally referred to as "oat-hay poisoning" or "nitrate poisoning." Losses are in the form of abortion of fetus or actual death of the animal.

At seeding rates of 96, 128, and 160 lbs. per acre, there was no significant difference in nitrate accumulation. This indicated no relationship between shading by adjacent oat plants and nitrate accumulation at these planting rates.

The average percentage nitrate content of oat stems, leaves, and heads was 1.52, 1.12, and 0.07 respectively (average of two varieties at two locations).

Varietal differences in nitrate content were significant but not always consistent at different locations.

Locations-by-varieties interaction was non-significant.

The location-by-years interaction was significant.

The interaction of years by stages of growth was non-significant.

The interaction of varieties by years was significant.

Although, in some locations, the nitrate content decreased as the oat plants matured, at other locations there was no significant difference in nitrate content between stages of growth, and in still other locations the nitrate content increased or varied erratically.

In general, nitrate accumulation in the hard-dough stage of growth was the same as, or significantly lower then, in the boot stage.

Field variations in four fields, with four to five samples from each field, were 0 to 0.78, 0.02 to 0.58, 0.04 to 0.60, and 0 to 0.02 percent.

Regrowth oats may be similar to non-regrowth stages in nitrate content, or at times, may be much higher.

U. Wyo., Agr. Expt. Sta., Laramie, Wyo.

51. Oertli, J. J. THE DISTRIBUTION OF BORON IN PLANTS. Zemljiste I Biljka 11(1-3): 371-376. 1962.

Boron is distributed very unevenly in plants. Its concentration varies a hundred-fold within the same leaf. The boron distribution patterns in leaves lead to the hypothesis that boron is principally moved with the transpiration stream. A simple mathematical description of the movement and distribution of boron in an idealized parallel veined leaf was developed. For this mathematical derivation it was assumed that boron moves in a uniform transpiration stream in the leaf, and as water is transpired the boron concentration will increase. In a parallel veined leaf boron should then be distributed in a hyperbolic fashion. The actual distribution of boron in parallel veined leaves is in accordance with this mathematical picture but short time absorption studies with cut leaves indicate that boron is moved rapidly in the vascular system and more slowly in interveinal areas. The hyperbolic distribution represents rather a final "equilibrium" state.

This hypothesis is further supported by the following observations: (1) The pattern of boron toxicity in various plants was related to the veination; and (2) substantial amounts of boron were lost from leaves through guttation.

The tolerance limits for boron are low, i.e. even small excesses of boron supply will result in toxicity. This is readily understood from our hypothesis which predicts that boron will be concentrated in localized areas which may be considered "sinks" of the transpiration stream. Because of this local concentration of boron in certain leaf areas, it is advisable to apply boron fertilizers with extreme caution.

U. Calif., Los Angeles, Calif.

52. Kenworthy, A. L., and Harris, N. COMPOSITION OF MCINTOSH, RED DELICIOUS AND GOLDEN DELICIOUS APPLES AS RELATED TO ENVIRONMENT AND SEASON. Mich. Agr. Expt. Sta. Q. B. 46(2): 293-333. 1963.

McIntosh apples from two sources and both Red and Golden Delicious apples from three sources were obtained for 3 years. Analyses were made for 26 constituents--water soluble pectin, oxalate soluble pectin, acid soluble pectin, total pectin, reducing sugar, non-reducing sugar, total sugar, reduced ascorbic acid, total ascorbic acid, titratable acidity, soluble solids, flesh firmness, dry matter, crude protein, total ash, crude fiber, ether extract, N-free extract, phosphorous, potassium, calcium, magnesium, manganese, iron, copper, and boron.

McIntosh apples varied between sources for 4 constituents, between years for 19 constituents with significant year x source interaction for 2 constituents.

Red and Golden Delicious apples varied between sources for 13 constituents, between varieties for 10 constituents, and between years for 21 constituents, with source x year interaction significant for 14 constituents.

Mich. State U., Agr. Expt. Sta., East Lansing, Mich.

53. Zink, F. W. RATE OF GROWTH AND NUTRIENT ABSORPTION OF CELERY. Proc. Amer. Soc. Hort. Sci. 82: 351-357. 1963.

Rate of growth and nutrient absorption were studied during the development of spring, summer, and fall crops of Utah type celery. Growth curves for plant fresh weight and percent dry matter were presented. A progressive acceleration in rate of increase in fresh weight occurred. Approximately 50 percent of the final fresh weight was produced during the 21-day period prior to harvest. Calculated fresh plant material produced by the aboveground portion of the crop ranged from 72 to 78 tons/acre. Percent dry matter decreased as the plants approached market maturity, and at harvest ranged from 6.1 to 8.6 percent.

Chemical analyses of the plants showed a tendency for total N and Mg to decrease as the plants approached market maturity. The Ca level remained nearly constant throughout the growth of the crops; Na tended to increase as the plants approached market maturity. The P and K content fluctuated some throughout the growth of the plant, with no general trend for the three trials.

Nutrient uptake curves for the aboveground portion of the crop were presented. Maximum rate of growth during the month before harvest was accompanied by maximum rate of nutrient uptake. At harvest, the crop had removed an average in pounds per acre of N, 280; P, 72; K, 635; Na, 155; Ca, 264; and Mg, 35.

U. Calif., Davis, Calif.

54. Golden, L. E., and Ricaud, R. THE NITROGEN PHOSPHORUS AND POTASSIUM CONTENTS OF SUGAR CANE IN LOUISIANA. La. Agr. Expt. Sta. B. 574, 20 pp. 1963.

Dry matter production and the uptake of N, P, and K by sugar cane were studied. The average amounts of nutrients in the entire growth, including roots, per ton of millable cane were 4.24 pound of N, 1.71 pounds of P_2O_5, and 6.74 pounds of K_2O.

Approximately 2.0 pounds of N, 1.0 pound of P_2O_5, and 3.5 pounds of K_2O left the sugar cane fields in the cane and trash per ton of millable cane.

The amount of N removed each cropping year in cane and trash plus the amount normally lost by burning trash from a 30-ton per acre yield was approximately 80 pounds of

N per acre. To maintain a balance between N lost from the soil and N added, full consideration must be given to gain of N in the soil from fixation of N by nonsymbiotic soil organisms, to gain from rainfall, to loss due to leaching, to loss in runoff water, and to loss from oxidation and reduction processes which occur in the soil.

A general increase of N in the crop occurred as the rate of N in N-only treatments increased. Some tendency toward a balancing effect by P_2O_5 and K_2O in fertilizers on the N uptake was noted.

Nitrogen in N-only fertilizers had a general lowering or dilution effect on P_2O_5 in sugar cane. Additions of P_2O_5 to the fertilizers resulted in yield responses to P_2O_5 in the fertilizers but did not cause consistent differences in P_2O_5 content of sugar cane. It was concluded that the amount of P_2O_5 in the soil can be maintained by additions of P_2O_5 to the soil in amounts equal to amounts removed in the millable cane and trash. The total amount of P_2O_5 in some soils cropped to sugar cane was seriously low when compared to the rate of removal by the sugar cane crop. Even in the more fertile soils P_2O_5 may become depleted within three or four decades.

The K_2O content of sugar cane decreased as the N in the N-only fertilizer treatments increased. Additions of K_2O to the fertilizers resulted in relatively consistent increases in yields and in K_2O content of sugar cane. The amount of K_2O removed each cropping year in cane and trash by a 30-ton per acre yield was approximately 105 pounds. The total amount of K_2O in soils cropped to sugar cane was medium or high. However, the amount of available K was generally too low for optimum yields.

Early in the growing season, rates of absorption of nutrients studied were relatively faster than rates of production of dry matter, but near the end of the season, dry matter production continued after little or no additional nutrients were absorbed. During the three-month period June, July, and August, approximately 75 percent of the N, 82 percent of the P_2O_5, and 85 percent of the K_2O were absorbed.

La. State U. and Agr. and Mech. Col., Agr. Expt. Sta., Baton Rouge, La.

55. McGee, C. E. A NUTRITIONAL STUDY OF SLASH PINE SEEDLINGS GROWN IN SAND CULTURE. Forest Sci. 9(4): 461-469. 1963.

In a greenhouse experiment conducted to determine the relationship of nitrogen, phosphorus, and potassium supply to slash pine seedling yield and composition, 30 combinations of N, P, and K were supplied to the seedlings for a 4-month growing period. The following conclusions were made:

1. The relative importance of nitrogen, phosphorus, and potassium varied in the production of different types of yield. Nitrogen was most influential as regards fresh weight yield, whereas potassium exerted the most influence on dry weight and seedling elongation.
2. Optimum growth response to nitrogen and potassium was indicated by regression analyses at supply concentrations greater than 125 but less than 625 p.p.m. Growth response to phosphorus was still increasing at 125 p.p.m., the maximum concentration of phosphorus supplied.
3. Variance in shoot-root ratios was largely a function of nitrogen supply. As the supply of nitrogen was increased, a greater percentage of the total dry matter of the plant was found in the shoot.
4. The percentage of nitrogen, phosphorus, and potassium found in the shoot and root tissue increased with each additional increment of nutrient supply.
5. The ratio of nutrient percentages present in shoot and root varied with each element. In all treatments, higher nitrogen percentages were found in the shoots than in the

roots. Generally, higher percentages of phosphorus and potassium were found in the roots than in the shoots.

6. Satisfactory dry matter yields are predicted when the potassium content of the shoot ranges from 0.5 to 0.7 percent of dry weight and other elements are present in adequate amounts.

Southeastern Forest Expt. Sta., FS, USDA, Asheville, N.C.

56. Price, N. O., and Hardison, W. A. MINOR ELEMENT CONTENT OF FORAGE PLANTS FROM THE CENTRAL PIEDMONT REGION OF VIRGINIA. Va. Agr. Expt. Sta. Tech. B. 165, 15 pp. 1963.

Three hundred and sixty-six forage samples from the Central Piedmont region of Virginia were analyzed for the minor elements--copper, cobalt, manganese, molybdenum, and zinc. The authors concluded that:

1. Assuming that 0.07 p.p.m. would be the minimum requirement for grazing animals, 71 percent of the grasses and 24 percent of the legumes were deficient in cobalt.
2. Assuming that 6.5 p.p.m. would be the minimum requirement for grazing animals, 93 percent of the grasses and 26 percent of the legumes were deficient in copper.
3. A sufficient amount of manganese, molybdenum, and zinc appeared to be present in the legumes and non-legumes to meet the needs of grazing animals.
4. No great differences were shown in the contents of these forages caused by sampling by years or soil types. Some small areas reflected changes in forage contents, which may be caused by soil conditions.
5. The copper and cobalt contents of the forages, non-legumes, and legumes showed the lowest levels in Nottoway County.
6. It was considered unlikely that deficiencies of the minor elements would occur in grazing animals, as long as mixed pastures of legume and non-legume plant species were available to the animal.

Va. Polytech. Inst., Agr. Expt. Sta., Blacksburg, Va.

57. Webster, J. E., Shyrock, G., and Cox, P. THE CARBOHYDRATE COMPOSITION OF TWO SPECIES OF GRAMA GRASSES. Okla. State U. Expt. Sta. Tech. B. T-104, 16 pp. 1963.

A comprehensive carbohydrate analysis of two species of grama grasses at different stages of growth was reported for 2-year period; and the results were compared with the conventional proximate analyses of the same samples. The author concluded that:

1. Marked seasonal changes were found in all constitutents for which analyses were secured. These changes were similar for the two species.
2. The overall composition of the two species were quite comparable, with the exception of four components.
3. Blue grama was consistently higher in protein content, although the overall advantage was only about 13 percent of the total.
4. Blue grama usually had a higher content of starch by diastase and mild acid hydrolysis values (they measure much the same fractions); although here the results, sampling by sampling, were not so consistent. The overall difference was 19 and 14 percent, respectively.

5. Sideoats grama consistently showed a higher percentage of soluble solids, and the overall difference exceeded 20 percent. This difference probably has little nutritional significance. Since the soluble sugars are similar for the two species, the difference probably is in the organic acid fraction.
6. Blue grama contained only about 76 percent as much lignin as sideoats grama. This should make the blue grama significantly more digestible.
7. The data indicate a very low content of both fructosans and starch when specific methods were used for their determinations. These values are so low that little or no nutritional significance can be attributed to these fractions.
8. The comparison of extracted hemicellulose (4 + 24 percent KOH) values with the strong acid hydrolysis values show a very close correlation, and a fair correlation was shown between the acid hydrolysis and calculated values. In this study where fructosans and starch were present only in very small amounts, the acid hydrolyzable values were probably a very satisfactory estimate of the total hemicellulose content of the plants, and certainly they were much simpler to determine.
9. Crude fiber values did not nearly equal the theoretical crude fiber sum of lignin plus celulose for these grasses.

Okla. State U. Expt. Sta., Stillwater, Okla.

58. Dudley, D. I. EFFECT OF DATE OF INITIAL HARVEST ON YIELD, PROTEIN CONTENT AND TOTAL YIELD OF PROTEIN OF SUDANGRASS VARIETIES, DENTON, 1962. Tex. Agr. Expt. Sta. Prog. Rpt. 2283, 4 pp. 1963.

Delaying the initial forage harvest of five Sudangrass varieties for 2 and 4 weeks resulted in hay yields of 4,800 and 6,550 pounds per acre, respectively, compared with a hay yield of 1,880 pounds harvested at the first appearance of heads. The percentage protein decreased markedly with advanced maturity, but the acre yield of protein was increased by delaying initial harvest either 2 or 4 weeks.

The stage of growth and development at the time of the initial cutting affected the amount of regrowth obtained during the balance of the growing season. Regrowth (harvested every 30 to 40 days after initial harvest) production following the early, medium, and late dates of first cutting were 4,560, 4,280, and 2,890 pounds per acre, respectively. The increase in regrowth produced after early initial harvest was not sufficient to offset the lower first harvest yield. The maximum yield of hay for the full season was obtained with the latest initial harvest while the greatest acre yield of protein was produced with the medium initial harvest date.

Tex. A & M U., Tex. Agr. Expt. Sta., College Station, Tex.

Soil Classification

SEE ALSO 24, 29, 35, 55, 77, 79, 85, 88, 94, 96, 108, 130, 145, 228, 238.

59. Franzmeier, D. P., and Whiteside, E. P. A CHRONOSEQUENCE OF PODZOLS IN NORTHERN MICHIGAN: I. ECOLOGY AND DESCRIPTION OF PEDONS. Mich. Agr. Expt. Sta. Q. B. 46(1): 2-20. 1963.

The retreat of the last glacier and a series of fluctuations of the level of the glacial Great Lakes during crustal uplift have resulted in surfaces of different ages in the northern

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tip of the southern peninsula of Michigan. Four such surfaces have been recognized by geologists who have determined their ages to be approximately 2,250, 3,000, 8,000, and 10,000 years old.

By selecting sites for uniformity of the remaining four groups of independent variables of soil formation, a chronosequence of soils was obtained. The morphological features associated with Podzols become more strongly expressed with increasing age of the soil. Current vegetation follows a succession from pine-oak associations to maple-beech associations on the age sequence of sites and thus this vegetation is dependent on the factor, time. The depth of the A_2-podzol B horizon boundary reaches equilibrium in a few thousand years.

Mich. State U., Agr. Expt. Sta., East Lansing, Mich.

60. Franzmeier, D. P., and Whiteside, E. P. A CHRONOSEQUENCE OF PODZOLS IN NORTHERN MICHIGAN: II. PHYSICAL AND CHEMICAL PROPERTIES. Mich. Agr. Expt. Sta. Q. B. 46(1): 21-36. 1963.

Soils of this sequence are classified as Spodic Orthopsamments, Entic Typorthods, and Alfic Typorthods in the Seventh Approximation. Early in the formation of these Podzols, carbonates and basic cations are leached from the sola. A pH gradient is established between the A and B horizons making it possible for some phosphates to be mobilized in the A horizon and immobilized in the B horizon. The segregation of extractable iron and aluminum into horizons also begins at about this time in the sequence. Later in the chronosequence, humus and finally clay are segregated into horizons of minimum and maximum contents of these substances. Throughout the time of formation, the average distance between sand grains increases in the Podzol sequum and the resulting space becomes partially filled with finer material. This results in a decrease in bulk density and an increase in the readily available water holding capacity.

Mich. State U., Agr. Expt. Sta., East Lansing, Mich.

61. Franzmeier, D. P., Whiteside, E. P., and Mortland, M. M. A CHRONOSEQUENCE OF PODZOLS IN NORTHERN MICHIGAN: III. MINERALOGY, MICROMORPHOLOGY, AND NET CHANGES OCCURRING DURING SOIL FORMATION. Mich. Agr. Expt. Sta. Q. B. 46(1): 37-57. 1963.

The layer-silicate clay minerals in the parent materials of all five soils of a chronosequence are predominately kaolinite, illite, and chlorite, but in the A_2 horizons practically the only 2:1 layer silicate present is montmorillonite. In the fine sand fraction amphiboles, pyroxenes, and aggregate minerals have weathered from the A_2 and to a lesser extent from the B horizon of the Podzols. Micromorphological evidence in the Podzol B indicates that first a weakly crystalline coating of sesquioxides and clay is formed around sand grains, and later an amorphous layer of humus, sesquioxides, and clay forms around this rim. This amorphous coating grows in thickness and eventually flakes off and becomes intergranular aggregates.

Mich. State U., Agr. Expt. Sta., East Lansing, Mich.

62. Mitchell, W. A. MINERALOGICAL ASPECTS OF SOIL FORMATION ON A GRANITIC TILL. Internatl. Clay Conf. 1963: 131-138. 1963.

Five horizons from an iron podzol soil profile derived from granitic till were separated into a large number of size fractions each of which was subjected to quantitative mineralogical analysis by X-ray and optical methods. The particle-size distribution curves of each mineral species were given, and the relative stabilities of the minerals and their weathering products were discussed with reference to clay mineral formation.

The alteration of biotite to trioctahedral illite and then to vermiculite was a straightforward process involving the release of potassium, but not necessitating any great structural rearrangement. The dioctahedral illite, the principal clay mineral, is probably formed mainly from the alteration products of the plagioclase felspar, a major component of the parent rock, and one which has been shown to weather rapidly, the necessary potassium coming from the biotite. The kaolin is probably also derived from the felspars.

It was difficult to assess the role of the current pedological cycle in clay mineral formation. The clay mineralogy of the glacial till has probably not altered much since deposition, and will therefore depend largely on interglacial pedological cycles, and on the small clay mineral content of the parent rock. The clay mineralogy of our soils today may not be very different from that of interglacial times, but the soils will have been enriched and rejuvenated by the incorporation of ground fragments of unweathered primary rock minerals.

Macaulay Inst. Soil Res., Craigiebuckler, Aberdeen, Scotland.

63. Hayes, M. H. B., and Mortensen, J. L. CHEMICAL AND PHYSICO-CHEMICAL CHARACTERISTICS OF RIFLE PEAT PROFILES. Ohio Agr. Expt. Sta. Res. C. 123, 11 pp. 1963.

Three distinct organic layers were observed in profiles of cultivated and virgin organic soil classified as Rifle peat. The plow layer had properties characteristic of muck, the intermediate layer was composed of dark-down, stratified fibrous material, and the basal layer was sticky, structureless, black in color, and probably contained gyttja or organic matter leached from surface layers and deposited on the mineral substratum.

Cation exchange capacity, DTA thermograms, electrophoretic mobility, calorific value, pyrophosphate solubility, and carbon-nitrogen ratios indicated that most of the organic matter throughout the profiles could be classified as muck.

The structure and composition of the soil throughout the profile indicated that it can be used for crop production until the organic matter is lost by subsidence.

Ohio Agr. Expt. Sta., Wooster, Ohio.

64. Cline, M. G., and Lathwell, D. J. PHYSICAL AND CHEMICAL PROPERTIES OF SOILS OF NORTHERN NEW YORK. N.Y. Agr. Expt. Sta. (Cornell) B. 981, 68 pp. 1963.

Physical and chemical properties of 8,515 samples of surface soils from the major soil groups from northern New York were given.

Tables and maps.

Cornell U. Agr. Expt. Sta., N.Y. Col. Agr., Ithaca, N.Y.

65. Tedrow, J. C. F. NEW JERSEY SOILS. N.J. Agr. Expt. Sta. C. 601, 20 pp. 1963.

A general picture of the major kinds of soils in New Jersey was given and their agricultural potential, limiting properties, and desirable features were indicated.

As a result of the different rocks from which soils were formed and a complex geologic history, soil conditions in New Jersey are diverse. Lines separating different geologic materials also frequently correspond to soil boundaries. An interpretative map was prepared that gives only the character of the underlying rock as it affects soil properties.

Discussion was limited to a few pertinent remarks concerning characteristics of the soil and use of the land.

Tables and maps.

Col. Agr., Rutgers - The State U., New Brunswick, N.J.

66. Arneman, H. F. SOILS OF MINNESOTA. Minn. Agr. Ext. Serv. Ext. B. 278, 8 pp. 1963.

The types of soil found on any farm or forest largely determine the type of farming, the crops to be grown, and the tree species that will grow most rapidly. Anyone concerned with land management should know the kind of soil he works with and what to expect from it.

The map given does not attempt to show all soil differences. Rather it shows the various areas where soils are related to one another or where entirely different soils occur in such close association that they cannot be separated on a map of this scale.

These soil groups are called soil associations and the map is called a soil association map.

Ext. Serv., U. Minn., St. Paul, Minn.

67. Hill, D. E., and Gonick, W. N. THE PAXTON SOILS. Conn. Agr. Expt. Sta. B. 662, 47 pp. 1963.

To gain a broader knowledge of the soil throughout its geographical range, available data are being assembled from each state on the important agricultural soils (benchmark soils). A monograph for the Paxton soils is especially significant for Connecticut since it is one of the major soils of the Eastern and Western Highlands covering more than 6 percent of the 3,135,000 acres in the State. The assemblage of all knowledge about the Paxton soils will aid soil scientists and technicians in properly identifying similar soils, interpreting their properties for various uses, and determining the needs for future study.

The Paxton soils are well-drained Brown Podzolic soils. Their notable characteristic is the compact layer found 22 to 24 inches below the surface that profoundly affects drainage.

These soils, found in all New England states and New York, are exemplified by picturesque hillside pastures and are among the most productive soils used for dairying in New England.

Although Paxton soils may be found in many situations, they are most common on drumlins, smooth hills that were elongated north to south by glacial movement. Here, the Paxton soils developed on compact till originally deposited beneath the glacier during the Late Wisconsin Age.

The upper portion of the compact till is a fragipan, a layer 18 to 28 inches thick whose platy structural units or peds are glazed with material such as clay which has washed or illuviated into this layer. The fragipan horizons, known locally as hardpan, are hard when dry, and even when moist are very firm.

Within the same drainage sequence or catena where Paxton is found, are the moderately well-drained Woodbridge, the somewhat poorly to poorly-drained Ridgebury, and the very poorly drained Whitman soils. Along lower slopes, the associates of Paxton are extensive, and higher up the slope they are confined to seeps.

Tables, maps, and profile descriptions.

Conn. Agr. Expt. Sta., New Haven, Conn.

68. Longwell, T. J., Parks, W. L., and Springer, M. E. MOISTURE CHARACTERISTICS OF REPRESENTATIVE TENNESSEE SOILS. Tenn. Agr. Expt. Sta. B. 367, 46 pp. 1963.

Some physical properties of many Tennessee soils were presented. Relationships between water storage and texture were pointed out.

As clay content increased, the available water holding capacity decreased but the decrease was not proportionate to the amount of clay. As sand increased, the moisture storage capacity decreased.

The available water holding capacity increased with silt and very fine sand content, and soils high in silt and very fine sand had the highest available water holding capacity.

Available water holding capacities of cherty soils were inclined to be low.

A relationship between permeability and aeration porosity was indicated.

U. Tenn., Agr. Expt. Sta., Knoxville, Tenn.

69. Brown, L. N. THE LACQUER CEMENT METHOD OF MAKING SOIL MONOLITHS. Calif. Agr. Expt. Sta. B. 795, 27 pp. 1963.

The lacquer cement method of making soil monoliths was described and illustrated. This method can be used on dry or nearly dry soils--not on wet soils. When the lacquer cement method is used, the soil in the finished monolith retains its dry color. These monoliths are very effective in classroom and Extension teaching, since it can be shown that the soil is made up of distinct horizons or layers, rather than being just an accumulation of dirt.

Making soil monoliths is an involved technical process. Four prime requisites are: Technical knowledge; ingenuity; physical dexterity; and patience.

U. Calif., Agr. Expt. Sta., Berkeley, Calif.

Wind and Water Erosion

SEE ALSO 1, 4, 19, 228.

70. Singleton, H. P. WIND EROSION CONTROL IN THE COLUMBIA BASIN PROJECT. Wash. Agr. Expt. Sta., Sta. C. 423. 18 pp. 1963.

The results of developing and operating the second Wind Erosion Control Farm, located in Block 20, Columbia Basin Project in Washington were given. The author concluded that:

1. The farm selected was as susceptible to wind erosion damage as any farm unit in the Columbia Basin Project.
2. Wind erosion was controlled by using the following practices recommended in reports on the first Wind Erosion Control Farm: (1) Cultivate when soil is wet to produce clods; (2) don't till when soil is dry; (3) use irrigation water wisely; (4) strip cropping is beneficial; (5) ridging may help; (6) crop residues are good protectors; (7) native cover can be used; (8) don't develop more land than you can properly handle; (9) level in late summer; and (10) avoid early land preparation.
3. Vetch and rye combined was a better cover crop than either vetch or rye alone.
4. On soils with a high infiltration rate, the shorter irrigation furrows used less water and produced more corn per acre than longer irrigation furrows.
5. Water loss from earth head ditches on soils with high infiltration rates was as high as 0.6 acre feet per 100 feet of ditch in 30 days.

Wash. Agr. Expt. Sta., Inst. Agr. Sci., Wash. State U., Pullman, Wash.

71. Schultz, H. B., Carlton, A. B., and Lory, F. INTERPLANTING METHODS FOR WIND EROSION PROTECTION IN SAN JOAQUIN ASPARAGUS. Calif. Agr. 17(9): 4-5. 1963.

An alternate method for analyzing the effectiveness of wind erosion protection in asparagus fields of the San Joaquin Delta peat regions substantiated previous results that showed the value of the practice of interplanting barley in every row. Better success with alternate row planting usually occured when the rows were placed perpendicular to the critical winds.

U. Calif., Davis. Calif.

72. Williston, H. L. EARLY YIELD OF EROSION-CONTROL PLANTATIONS IN NORTH MISSISSIPPI. U. S. Forest Serv. Res. Note SO-1, 7 pp. 1963.

A survey of 8,005 acres of pulpwood-size pine plantations on eroded sites showed that survival was 38 percent in loblolly, 48 percent in shortleaf, and 29 percent in slash. Average annual growth per acre was 0.89 cord for loblolly, 0.58 cord for shortleaf, and 0.88 cord for slash. Form class was 2 to 3 percentage points better in loblolly than in shortleaf.

While the data are too incomplete for firm conclusions, some tentative observations were made for managing erosion-control plantings.

Pine plantations improved the characteristics of the upper soil profile. They not only protected the site with their heavy litter but also gradually improved infiltration rates and the moisture-holding capacity of eroded soils. Ultimately the productivity will be improved.

Care of pine plantations during the first 5 years is extremely important. All failed areas of 1/10 acre or larger should be promptly replanted. If undesirable hardwoods are growing within the plantation, they should be deadened soon after the pines are planted. A follow-up killing of hardwood sprouts is frequently needed 3 to 5 years after planting. Firelines should be plowed between the plantation and all adjacent roads. Large plantations should be broken into 40-acre blocks with natural barriers and plowed firelines.

Site protection as well as maximum timber production should be primary objectives in managing pine plantations established on highly erosive soils. To meet these objectives, thinning should be primarily from below. Very little thinning, except for salvage, should be done in gullies or on gully edges. Close spacing of logging roads will prevent overuse and thus minimize rutting and soil exposure. Logging crews should be trained in site-protection practices and closely supervised.

If quality saw logs are the primary objective of management, stands should be thinned to a basal area of approximately 85 square feet per acre on good sites and 70 square feet on fair sites. Basal areas 15 feet greater than these should be left if maximum pulpwood production is desired. The minimum operable cut per acre is 3 cords. On sites with an index of 80 or better, a 3-year cutting cycle is feasible for loblolly pine; on poorer sites, a 5-year cutting cycle is feasible. Cutting cycles for shortleaf pine should be 5 years on sites of 70 or better and 7 years on poorer sites. Heavy cuts increase erosion risks, but involve longer cutting cycles with less frequent site disturbance.

On all but the most severely eroded sites, erosion-control plantations will produce merchantable wood. Annual volume growth of a stand generally increased substantially following the first thinning, because of rapid increases in diameter, form class, and merchantable height. Gross returns from clear cutting loblolly plantations at 20 years of age will approximate 20 cords per acre. But three thinnings made at 5 year intervals starting at age 20 will return this much and leave the landowner with a stand worth as much as or more than the wood removed--a stand increasing in value each year as it approaches saw log size.

Southern Forest Expt. Sta., FS, USDA, New Orleans, La.

73. Ursic, S. J. PLANTING LOBLOLLY PINE FOR EROSION CONTROL IN NORTH MISSISSIPPI. U.S. Forest Res. Paper SO-3, 20 pp. 1963.

Loblolly pine is widely planted for soil stabilization and the rehabilitation of denuded, actively eroding uplands of the upper Gulf Coastal Plain in north Mississippi and west Tennessee. Methods and specifications that recent research has developed for such planting were described and illustrated.

Southern Forest Expt. Sta., FS, USDA, New Orleans, La.

Terracing

74. Jacobson, P. NEW METHODS OF BENCH TERRACING STEEP SLOPES. Trans. ASAE 6(3): 257-258, 261. 1963.

Bench terracing has been suggested as a measure for controlling erosion in the deep loess areas. The soils are generally deep and of fairly uniform texture throughout the profile. They will permit cuts of 2 or 3 ft. without exposing infertile subsoil of inferior texture. The benches will be on a slope which by natural process becomes stable (4 percent or less). The soils will absorb and store much of the moisture that falls. Since much of the loess area is characterized by steep slopes, the cost of developing the benches has not been economical.

Since erosion and farming operations are tending to bench land, why not let the natural process do the job? The stage can be set by correct spacing and proper alignment. Then nature over a period of time will bench the area.

Observations on terraces show they are benching. In the West Tarkio project near Shenandoah, Iowa, terraces built 20 to 30 years ago are almost completely benched.

A set of terraces was laid out and constructed in the fall of 1961 on slopes ranging from 14 to 16 percent in Crawford County, Iowa. The terraces were mainly constructed from the downhill side. The downhill slope was made steep and will be left in permanent grass. The method of construction tended to reduce the land slopes which are farmed rather than to increase them.

The spacing was adjusted so that, when the benching process is completed, the rows on the bench are a multiple which can be handled by modern farm equipment. The downhill slope of the terrace was made to average 3 feet horizontal to 1 foot vertical. In construction, the downhill slope of the terrace was varied between $2\frac{1}{2}$ to 1 and $3\frac{1}{2}$ to 1 to provide uniform width of farmed area and avoid point rows.

SCS, USDA, Des Moines, Iowa.

Critical Areas

75. Diseker, E. G., Richardson, E. C., and Hendrickson, B. H. ROADBANK EROSION AND ITS CONTROL IN THE PIEDMONT UPLAND OF GEORGIA. U.S. Dept. Agr., Agr. Res. Serv. ARS 41-73, 40 pp. 1963.

A project was started in 1956 with field headquarters at Cartersville, Ga. to: (1) Measure soil and water losses from a series of typical bare roadbanks; and (2) test a wide range of vegetative and treatment methods to determine those most satisfactory for permanent roadbank protection.

The runoff and erosion soil losses from roadbank areas were reported for 1957-59. Each plot consisted of a bare cut roadbank and ditch with adjacent vegetated road shoulder, varying in size from 0.16 to 0.30 acre per total runoff area. The banks varied in height from 2 to 16 feet, with lengths of 206 to 365 feet. Heavy annual losses occurred on all bare roadbanks, with losses ranging from 25 to 359 tons per acre.

Frost action was a major factor in losses from most of the banks except for newly sloped, firm banks. Orientation of the roadbanks greatly influenced frost action and erosion. All banks facing the northwest yielded twice as much soil loss as those facing the southeast due to the direct beating action of rainstorms.

Annual seasonal losses from roadside areas depended mainly on the rainfall pattern from March through July after the soil had been loosened on the banks by frost action. A heavy rainfall would wash large quantities of deposited soil from the flow channel at any time of the year.

Twenty-eight different species and varieties of roadbank covers were planted with and without mulch on well fertilized areas during the roadbank stabilization studies during 1956-60.

To a great degree, the sod-forming grasses and legumes were successful on friable soils and lower slopes, whereas on the difficult soils and steeper, higher roadbank slopes were stabilized more easily with vine-type plants that were planted near the bottom and at the top of the bank.

Fescue was superior to other grasses for fall planting and it was vigorus and free from disease. Abruzzi rye provided quick cover, produced mulch in place, and was a good nurse crop for slow-growing legumes. Crownvetch was a promising cool-season, perennial legume, but required 2 or more years to develop cover whether seed or plants were used. Common bermudagrass and lovegrass were the best perennial summer grasses. Wilmington

and Pensacola bahiagrasses produced good cover, but developed slowly. Sericea provided good cover in full stands, but was thinned by late summer mowing.

Honeysuckle and kudzu were the best vine-type plants for rough areas. English ivy survived poorly and grew slowly. Vinca minor was hardy and developed faster than English ivy. Both were injured by sunscald on southern and western exposures. Daylilies grew well on all slopes and exposures and bloomed for about 6 weeks.

Broomsedge was cut when seed were mature, and a light mulch of it was made on unprepared banks. When the seed germinated the following spring, fertilizer stimulated the seedlings to full cover. Good cover was developed on a number of areas by fertilizing thin natural stands of broomsedge.

Mulch was essential on steep slopes for slow-developing plants. Mulch anchored the seed and fertilizer in place, insulated the soil against frost damage, and reduced erosion. It was not so essential for rapidly developing plants on moderate slopes. In general, the crop straws applied at the rate of 1 to 2 tons per acre gave best results.

The addition of adequate amounts of nitrogen, phosphorus, and potash was necessary to grow satisfactory cover on roadbanks. Much of the added fertilizer was washed off, leached out, or used up, leaving the plants undernourished.

SWCRD, ARS, USDA, Cartersville, Ga., 30120

76. Ruffner, J. D., and Hall, J. G. CROWNVETCH IN WEST VIRGINIA. W. Va. Agr. Expt. Sta. B. 487, 19 pp. 1963.

Sixty-four crownvetch evaluation plantings were established on a variety of critical conservation problem sites during 1952-62. Good or better cover was established on more than 80 percent of the sites.

Crownvetch produced more dense cover earlier than sericea lespedeza on roadbanks, shallow shale soils, and strip mine spoil where the spoil acidity was above pH 5.5. Frost seedings produced successful stands on roadbanks and strip mine spoil outerslopes. Poor stands consistently resulted from frost seedings on compact, heavy silty clay strip mine spoil.

Table. Site Preparation, Mixtures, and Dates of Seeding for Crownvetch

Site	Lime	Fertilizer (lb/Acre)	Suggested Seeding Dates	Straw Mulch (Ton/Acre)	Seed Mixture (lb/Acre)
New roadbanks, earth dams, cuts and fills, etc.	Lime to pH 6.5	1000 lb. 10-10-10	April 1 to May 15	1½ ton*	20 lb. Crownvetch and 30 lb. Tall fescue
			July 15 to Aug. 15	2 ton	20 lb. Crownvetch and 30 lb. Tall fescue
			Oct. 15 to Nov. 15	2 ton	20 lb. Crownvetch and 30 lb. Tall fescue†
Old roadbanks, ‡ etc., with partial grass cover.	Lime to pH 6.5	400 lb. 0-20-20	Frost seed on or before March 15	(Optional) 1½ ton on bare areas	10 to 20 lb. Crownvetch
Strip mine spoil outerslopes--pH 5.5 or above	None	None	Frost seed on or before March 15	None	15 lb. Crownvetch and 20 lb. Ryegrass or 20 lb. Crownvetch
Seed production**	Lime to pH 7.0	400 lb. 0-20-20	April 1 to May 15	None	8 to 10 lb. Registered Crownvetch seed

*On steep slopes, straw mulch must be held in place. This can be done by use of an asphalt emulsion, paper netting, twine and wood pegs, or with lightweight poles, saplings, or brush.

†Seed grass only in the fall. Frost seed crownvetch about March 15.

‡No more than 50 percent cover.

**Refer to Crownvetch Seed Production publication.

Seeding rates of 20 pounds per acre in conventional roadbank seedings were adequate when used with a grass, such as tall fescue at 30 to 40 pounds per acre. Cover was improved during the first year or so by including grass with the crownvetch. A complete fertilizer increased cover of crownvetch on strip mine spoil about 20 percent during the first year.

The legume was winter hardy at 4,000 feet elevation and withstood the drought on the shallow shale soils found in the Eastern Panhandle of West Virginia. It established well as an overseeding with shrubs and tree plantings, and tolerated semi-shaded sites.

Four plantings, 8 to 10 years old, continued to grow satisfactorily without maintenance.

In plantings more than a year old, cover developed faster on sites exposed to the north and east. Approximately 75 to 90 percent of these sites had good or better cover, while southern and western exposires had only 25 to 50 percent good and better stands.

In 1962, a bountiful seed crop was harvested from crownvetch growing on shallow shale soils in the Eastern Panhandle of West Virginia.

W. Va. U., Agr. Expt. Sta., Morgantown, W. Va.

SOIL MANAGEMENT

Cropping Practices

SEE ALSO 185, 203, 218, 264.

77. Harper, H. J. EFFECT OF LEGUME ROTATIONS AND NITROGEN FERTILIZATION ON WINTER WHEAT PRODUCTION IN OKLAHOMA. Okla. State U. Expt. Sta. Proc. Ser. P-466, 51 pp. 1963.

The effects of fertilizers and legume rotations on wheat production were studied on Kirkland 1 (a clay pan soil) at Stillwater, Okla., from 1926-57. Superphosphate applied to wheat planted every year produced an average net profit of $2.18 per acre over the 31-year period. An Austrian winter pea-wheat rotation provided a more favorable soil environment for optimum wheat production than cowpeas or sweetclover the first season after these legumes were grown in a 3-year rotation with the wheat. The average yield of wheat straw was higher where lime and superphosphate were applied and sweetclover was grown every third year than on plots where Austrian winter peas were planted. A 3-year rotation was too short to measure the maximum benefit from a wheat-sweetclover rotation on this soil. A profitable response from potash fertilization was not obtained because the soil was high in exchangeable potassium. Lime was needed for the growth of sweetclover and improved nodule development on Austrian winter peas but was not profitable where wheat was planted every year and fertilized with superphosphate and potash.

The yield of wheat grown in 2-, 3-, 4-, and 6-year rotations with sweetclover on Norge 1 containing .07 percent of total nitrogen was higher than yields obtained from continuous wheat plantings where superphosphate was applied alone or with lime. Wheat yields were increased 7.9 bushels per acre on plots where sweetclover was grown in the various rotations from 1943-53--a period after lime had been applied and fair-to-good crops of sweetclover had been returned to the soil. Sweetclover supplied about 27 percent of the nitrogen in the grain and 52 percent of the nitrogen in the straw removed from plots on which this legume was grown. An application of lime was needed at least once every 10 years to maintain a favorable condition for the growth of sweetclover. The combined effect of an abundance of available nitrogen released from the decay of sweetclover residues, warm winter weather, a dry subsoil, and lack of spring rains resulted in lower wheat yields the first year

after the sweetclover than the second year in 7 of the 20 years. Some changes in soil and crop management that were found to compensate for the harmful effect of a deficiency of subsoil moisture resulting from the growth of sweetclover were: (1) More shallow primary tillage to reduce the rate of organic matter decay the first year that sweetclover residues were returned to the soil; (2) planting wheat a week to 10 days later in the fall during seasons when subsoil moisture was limited; and (3) moderate grazing in late winter to remove excessive vegetative growth.

A large yield of Austrian winter peas grown for soil improvement on Grant vfsl in Garfield County, increased total wheat production, over a 5-year period of 25.3 bushes per acre over yields on adjacent land planted in wheat every year without nitrogen fertilizer.

Ammonium nitrate applied on wheat straw immediately after combining, at the rate of 100 pounds per acre, increased average wheat production 5.8 bushels per acre per year over a 5-year period on Pratt sl.

Nitrogen fertilizers applied in midwinter, at the rate of 32 pounds per acre, to wheat planted on nine soil types in central and west-central Oklahoma did not increase grain production except on one type of soil during one season when severe summer and fall droughts impeded liberation of plant nutrients from decayed organic matter.

Okla. State U. Expt. Sta., Stillwater, Okla.

78. Brengle, K. G., and Greb, B. W. COMPARISON OF CONTINUOUS WHEAT AND WHEAT AFTER FALLOW IN COLORADO. Colo. Agr. Expt. Sta. B. 518 S, 10 pp. 1963.

Wheat grown annually and wheat after fallow were compared at two locations in Colorado. Winter wheat was used near Amherst and spring wheat was used near Hayden. Nitrogen and phosphorus applications were made to both cropping systems.

Fallow was found to be necessary in the production of spring wheat in northwestern Colorado. It was important as a means of controlling weeds which compete with the crop for water. Responses to nitrogen were obtained only once in 4 years at this site.

At Amherst, fallowed wheat outyielded continuous wheat when the unfertilized plots were compared over a period of 3 years. For this period there was a significant nitrogen X cropping interaction. Yields were increased on the continuous system and decreased on the fallowed wheat by the application of nitrogen fertilizer. The statistical design of the experiment did not permit accurate evaluation of the nitrogen effect with one cropping system but the trends shown by this interaction were quite evident. Comparison of the test plot with the highest average yield indicates that continuous wheat with 25 to 30 pounds of nitrogen added as fertilizer may economically compete with fallowed winter wheat in this area.

Agr. Expt. Sta., Colo. State U., Fort Collins, Colo.

79. Hovland, D., Brage, B. L., and Pringle, W. TWENTY YEARS OF SOIL MANAGEMENT STUDIES AT CENTRAL SUBSTATION, HIGHMORE, SOUTH DAKOTA. S. Dak. Agr. Expt. Sta. B. 513, 8 pp. 1963.

Current soil studies at the Central Substation concern improved methods of management for Williams soils. This soil is a major series on the Missouri Coteau (an uneven upland in the north central part of South Dakota between the Missouri River and the James River lowland).

Even though the 20-year crop yield averages reported for narrow strips favor moldboard plowing over subsurface tillage, the results for individual years suggest seasonal adjustment of tillage. For example, use subsurface tillage when there are small amounts of crop residues and when soils are dry and more subject to wind erosion. When soil moisture is more favorable and weeds are a major problem and there is a great deal of straw, it may be better to use a moldboard plow.

The author concluded that the following practices should be included in the management of Williams soils for producing spring wheat: (1) Substitute sorghum for fallow in the cropping sequence, if there is a market or need for livestock feed; (2) return all residues not used for livestock to the soil; (3) incorporate all available manure into the soil; (4) apply phosphorus fertilizer when seeding small grain crops, particularly wheat; and (5) use nitrogen fertilizer where manure is not available or a crop does not follow fallow.

Agr. Expt. Sta., S. Dak. State Col., Brookings, S. Dak.

80. Butler, J. D., and Slife, F. W. LAWN WEEDS: IDENTIFICATION AND CONTROL. U. Ill., Col. Agr., Coop. Ext. Serv. C. 873, 27 pp. 1963.

A key for identifying common lawn weeds, a descriptive list of these weeds, including photographs and drawings, and a descriptive list of less common weeds were given. The weeds in these descriptive lists appear in alphabetical order under "Broadleaved Weeds" and "Grassy Weeds." They were listed by the most common name, followed by other common names, if any, and the botanical name.

A general discussion of weed control and a list of controls for specific weeds were included. This list includes instructions for: (1) Use of the material; (2) the best time to apply; and (3) the probable degree of control for each weed.

U. Ill., Col. Agr., Coop. Ext. Serv., Urbana, Ill.

81. Morre', D. J., and Fletchall, O. H. GERMINATION-REGULATING MECHANISMS OF GIANT FOXTAIL (SETARIA FABERII). Mo. Agr. Expt. Sta. Res. B. 829, 25 pp. 1963.

In field and greenhouse studies on the germination of giant foxtail seed, the authors concluded that:

1. The factors that regulate the germination of giant foxtail (Setaria faberii) dispersal units were attributed primarily to embryo dormancy as quantitatively influenced by the maturity of the seed at the time of dispersal. Embryo dormancy is broken in late February or early March by stratification in the soil under field conditions. After-ripening of a portion of the seed populations stored at room temperature is accomplished at approximately the same time but maximum germination does not occur until the following season.
2. Nondormant seeds germinated over a wide range of temperatures (15° to 30° C.; optimum 20° to 25° C.) in both light and dark.
3. Whereas the bulk of the dispersal units are apparently permeable to water, permeability may limit germination in certain seeds in which germination is induced by scarification.
4. The critical depth for emergence of giant foxtail seedlings was encountered between 3 and 4 inches below the soil surface. In natural population of giant foxtail on tilled soil, 55 percent of the seedlings resulted from surface germinations with near surface germinations accounting for much of the remainder.

5. Many of the buried seeds which do not germinate or emerge are eventually destroyed by soil organisms. Some remain viable for at least 4 years producing yearly reinfestations.
6. Freshly harvested dispersal units were resistant to attack by microorganisms, a feature restricted to the bracts.
7. The caryopses of the dispersal unit contained a water soluble germination inhibitor absent from the bracts. Extraction of the inhibitor failed to increase germination.
8. Germinability was a linear function of maturation time on the parent plant although the pattern of after-ripening was not changed appreciably. Coloration of the inner bracts (lemma and palea) provided an accurate index of seed maturity.
9. Seed production was estimated at 870 seeds per panicle or an average of about 7,500 per plant. Isolated plants growing on fertile soil may produce over 20,000 seeds per plant.
10. In general, germination of giant foxtail dispersal units is a cyclic phenomenon with maximum germination occurring in the spring independent of external conditions.

U. Mo., Col. Agr., Agr. Expt. Sta., Columbia, Mo.

Crop Residue Management

SEE ALSO 46.

82. Alderfer, R. B. SOIL ORGANIC MATTER. N.J. Agr. Expt. Sta. C. 422A, 16 pp. 1963.

Twenty eight questions on soil organic matter were answered.

N.J. Agr. Expt. Sta., Col. Agr., Rutgers - The State U., New Brunswick, N.J.

83. Hiltbold, A. E., and Cope, J. T., Jr. SOIL ORGANIC MATTER NOT INCREASED BY NITROGEN APPLICATIONS. Highlights Agr. Res. 10(2): 9. 1963.

Whether soil organic matter could be increased by adding abundant nitrogen to corn, where the only source of organic matter was the corn stover produced under continuous cropping was determined.

Two rates of commercial nitrogen were applied, 80 and 400 lb. per acre. The lower rate was considered adequate for maximum yields in average years. The high rate was chosen to supply additional nitrogen for conversion of crop residues into humus. One-fourth of the large amount was broadcast in the fall after stalks were cut.

The experiment was on Chesterfield sl that had been in continuous corn at the 80 lb. N rate for the previous 8 years. Soil organic nitrogen and carbon were determined in 1956, 1958, and in 1961.

Corn yields averaged higher from 400 lb. N (80.8 bu.) than from the 80-lb. rate (71.2 bu. per acre).

Initial carbon and nitrogen values indicated a low soil organic matter content, about 0.8 percent. During 5 years of cropping there was little or no change in organic carbon and nitrogen at either the 80 or 400 lb. N rate. Analysis of the subsoil for carbon and nitrogen showed no effect of the nitrogen fertilization. Neither was there any carryover of inorganic nitrogen within the surface foot of soil.

Of the 1,920 lb. of N applied in excess of the 80 lb. rate during the 6 growing seasons, only about 42 lb. was recovered in the extra yield, leaving 1,878 lb. of N that disappeared from the soil. Failure of this nitrogen to accumulate as humus in the soil is probably the result of climatic soil, and cropping conditions that favor rapid and complete decomposition.

Agr. Expt. Sta., Auburn U., Auburn, Ala.

Tillage

SEE ALSO 79, 97, 137, 185, 190, 194, 198.

84. Perkins, H. F. DEEP TILLAGE AND INCREASED LIGHT HAVE FAVORABLE INFLUENCE ON CORN PRODUCTION. Ga. Agr. Res. 5(2): 11-12. 1963.

Certain factors which may influence corn yields in the Piedmont area of Georgia were evaluated. The following preliminary observations were made from data obtained during the first year of investigation.

1. Tillage and placement of fertilizer and lime to a depth of 14 to 16 inches appeared to increase corn yields as compared to conventional tillage and fertilizer and lime applications to a depth of 6 to 8 inches.
2. Suspension of strips of aluminum foil from wires between rows increased light on the lower part of the plants and appeared to prolong the life of the lower leaves of the plant and to increase corn yields. A yield of 214 bushels per acre was obtained from this treatment.
3. Deep tillage of 14 to 16 inches appeared to reduce lodging of plants as compared to conventional tillage to a depth of 6 to 8 inches.

Table. Influence of Certain Practices on Corn Production. Athens, Georgia. 1962.

Treatment	Stalks/A	Lodging	Barren stalks	Ears per plant	Size of ears			Yield shelled corn/A
					0.2 lb.	0.2-0.35 lb.	0.35 lb.	
	no.	%	%	no.	%	%	%	bu.
A. Land preparation 6-8 in.	25,546	36.3	1.8	1.23	19.7	22.0	58.3	169
B. Land preparation 14-16 in.	25,305	15.2	4.0	1.19	17.5	23.7	58.8	192
C. Land preparation 14-16 in. plus A1 reflectors	25,877	7.1	0.8	1.24	19.2	29.5	51.3	214
D. Land preparation 14-16 in. spacing - 16½ in. sq.	26,555	26.5	1.2	1.24	15.5	33.7	50.8	188
E. Land preparation 14-16 in. manure vertically placed in trench	25,648	24.7	0	1.26	16.7	26.5	56.8	181
F. Land preparation 14-16 in. trench without manure	24,847	13.9	4.1	1.17	12.3	31.3	56.4	174

Ga. Agr. Expt. Sta., U. Ga., Col. Agr., Athens, Ga.

SEE ALSO 13, 16, 18, 21, 22, 24, 25, 28, 35, 42, 48, 49, 50, 51, 52, 53, 54, 55, 56, 77, 78, 79, 83, 180, 185, 197, 218, 219, 276, 278.

85. Grunes, D. L., Haise, H. R., Turner, F., Jr., and Alessi, J. RELATIONSHIP BETWEEN YIELD RESPONSE TO APPLIED FERTILIZERS AND LABORATORY MEASURES OF NITROGEN AND PHOSPHORUS AVAILABILITY: Soil Sci. Soc. Amer. Proc. 27:675-679. 1963.

Surface soils (generally 0- to 7-inch depth) and subsoils (generally 7- to 21-inch depth) were collected from sites in 13 Western States. Total N, initial NO_3-N, NO_3-N present after incubation, and $NaHCO_3$-soluble P were determined on all samples. On 14 surface soils, these laboratory measures were correlated with values of N and P availability obtained in a controlled light-temperature plant growth chamber.

Growth response to applied N was highly correlated with nitrates in nonincubated soils, as well as with nitrates present following incubation. However, correlations were better with the sum of the NO_3-N produced during incubation and the NO_3-N present in nonincubated soils, than with only the NO_3-N produced. Correlation coefficients were higher when the soils were incubated 3 weeks, rather than 6 weeks, and also when no $CaCO_3$ was added to the soil prior to incubation.

The following measurements were good predictors of increase in barley yields following N fertilization in growth chamber experiments: NO_3-N in nonincubated soils; NO_3-N present following incubation; total N in plants from non-N plots; "N" values of Munson and Stanford; and relative uptake of total N by plants in the P and NP plots.

The following measurements were good predictors of yield increases of barley when P was applied in the growth chamber: $NaHCO_3$-soluble P; A values of Fried and Dean; total P in plants from non-P plots; and relative uptake of total P by plants in the N and NP plots.

In 46 field trials, laboratory measures of available N in the soil were compared with yield response to applied N fertilizers. Similarly, in 44 field trials yield response from applied P was compared with $NaHCO_3$-soluble soil P. When the laboratory estimate for available soil N or P was low, growth response to fertilization was generally obtained in the field studies. When the soil level of available P was high, there was generally no yield increase following the addition of P fertilizer. However, yield response sometimes occurred on sites having high soil test values for available N.

Differences, in the ability of the N and P laboratory tests to predict response to fertilization in field trials, were attributed to the influence of climate. Except for the relatively small amounts of initial available N in the soil, soil moisture and temperature determined the N supply from mineralization. However, mineralization of organic P may not be very important for supplying P to plants on soils having fairly high initial $NaHCO_3$-soluble P levels.

H. R. Haise, SWCRD, ARS, USDA, Fort Collins, Colo., 80522

86. Oertli, J. J., and Lunt, O. R. LIQUID FERTILIZATION IN SOME AGRIKULTURAL [AGRICULTURAL] OPERATIONS. Zemljiste I Biljka 11(1-3): 297-301. 1962.

Within the past decade, much of the floral and landscape plant industry in California has changed successfully to liquid fertilization programs, whereby plants are irrigated with nutrient culture solutions. Many producers grow their plants in artificial soils composed of mixtures of sand and peat.

Various devices have been constructed to add fertilizers directly to the irrigation water. One such device, the Smith proportioner was described.

Liquid fertilization will produce equal quantities and qualities of plants as the best dry fertilization. It results in a considerable saving of labor, and permits uniform applications of known quantities of nutrients preventing deficiencies if used properly. The method usually results in greater fertilizer usage, but the increased cost is more than offset by other advantages the principal of which is a near perfect fertility program.

U. Calif., Los Angeles, Calif.

87. Spivey, C. D., Woodard, O. J., and Harmon, S. A. FERTILIZER AND VARIETY EXPERIMENTS ON CABBAGE IN SOUTH GEORGIA. Ga. Agr. Expt. Sta., C. N. S. 37, 23 pp. 1963.

Applying 10 tons of manure per acre in conjunction with a high analysis fertilizer such as an 8-8-8 gave relatively high yields of cabbage in the 1st through 5th year.

The direct correlation of high yields, satisfactory head weight, and compactness of heads was indicative of good results from high-analysis fertilizers.

The results from the rate of fertilizer tests were highly significant for yields. The authors conclude that 2,000 pounds of an 8-8-8 was best for the lighter sandy type soils, provided the fertilizer was applied in 500-pound increments. The higher rate increased head weight and the number of heads that survived transplanting. At the higher rate, the compactness of the heads was also more desirable. The rate of application on heavier type soils probably should be less since leaching is not as rapid.

Source of nitrogen derived from materials that were organic or from those that were ammonia formers tended to give more desirable yields of cabbage than most inorganic forms. The yield, head weight, and number of heads were more directly proportional, with the compactness of the head more erratic.

The increase in average head weight which occurred as the drill spacing was increased was attributed to a lesser number of plants per acre, since more plant food was available to each individual plant. However, the not-too-large heads were more desirable for the present day market. Fifteen-inch spacing in the drill tended to give the best overall results.

All varieties produced satisfactory yields and marketable heads; however, some were more outstanding than others, especially in compactness of the head. Large loose heads such as those found in the All Season variety were not desirable.

Marion Market and Round Dutch produced the most compact heads. However, the less compact heads, of a deep green color, are gaining in popularity.

Ga. Coastal Plain Expt. Sta., U. Ga. Col. Agr., Tifton, Ga.

88. Mikkelsen, D. S., and Miller, M. D. NITROGEN FERTILIZATION OF RICE IN CALIFORNIA. Calif. Agr. 17(8): 9-11. 1963.

Japonica rice is grown in the Central Valley of California primarily on dense clay soils under continuous flooding. Nitrogen is usually insufficient in these soils for optimum rice production, and nitrogen fertilization increased average yields about 40 percent. In some instances, nitrogen and phosphorus together were essential for optimum yields. Potash and other nutrient elements were usually adequate.

Consistently better vegetative growth and higher grain yields were obtained when rice was fertilized with ammonium rather than nitrate nitrogen. The two forms differ mainly in

their retention and subsequent availability under submerged soil conditions. Ammonium nitrogen placed 2 to 4 inches beneath the dry soil surface, and just ahead of flooding, did not undergo significant transformation and was better retained and more available to rice. Nitrate nitrogen was not efficiently used since it was subject to denitrification under flooded conditions. Reductive conditions developed in these soils within 3 to 5 days after flooding.

Sub-surface (drilled) placement of ammonium nitrogen produced better growth and yields of rice than other methods of application. Average yield indices were: 142 when equal amounts of nitrogen were drilled 2 inches and 140 when drilled 4 inches deep before flooding; 126 when broadcast on the soil and disked; 121 when broadcast on dry soil; and 108 when broadcast into the water after flooding. The width of the fertilizer-drilled rows did not affect yields in spacings up to 18 inches, but earlier seedling responses were obtained with 6 and 12 inches spacings.

The most efficient use of nitrogen was obtained by drilling all of it into the dry seedbed ahead of flooding. Split applications of nitrogen with one half applied ahead of flooding and the balance applied as a top dressing in the water were occasionally equal, but seldom better than a single pre-flooding soil application. Supplementary nitrogen applied to correct deficiencies which develop can be broadcast into the water. Top dressed nitrogen was utilized most efficiently if applied between 35 and 50 days after planting--the period of tiller development of the crop.

Fertilizer salts were easily compared in efficiency as nitrogen sources with near ideal placement of 2 to 4 inches, but ammonia solutions and anhydrous ammonia must be placed deeper in the soil to achieve satisfactory retention. Using the best placement procedures for each material, the relative efficiency of each (using ammonium sulfate as 100) was: ammonium chloride 97, cyanamide 92, urea 90, aqua ammonia (20 percent N) 85, anhydrous ammonia 83, and ammonium nitrate 57.

U. Calif., Davis, Calif.

89. Jones, L. S., and Anderson, O. E. EFFECTS OF RATES OF NITROGEN ON CORN FORAGE PRODUCTION. Ga. Agr. Res. 5(2):8-9. 1963.

An area of Cecil sl previously cropped to corn for grain, was planted for 3 successive years to Ga. 102 corn at 22,000 plants per acre. Nitrogen was added as ammonium nitrate each year in a split application--one-half soon after emergence of seedlings and one-half when the corn was about 2 feet high. Rates of nitrogen applied were 0, 50, 100, 150, 200, 300, and 400 pounds per acre, each replicated three times in a randomized block design. Phosphate and potash were broadcast at rates of 120 pounds per acre in 1960 and 1961, and at rates of 100 and 200 pounds per acre, respectively, in 1962. The crop was irrigated when it appeared the corn was under moisture stress with 1 1/4 inches of water at each irrigation.

Yields of forage were determined by cutting and weighing one-half of the two center rows of each plot. Nitrogen and potassium content of the plant tissue was determined by analyzing samples of the entire above-ground portion of the plant, including the immature ears.

Though some increase in the production of forage was noted for each added increment of nitrogen (Table), the increases were progressively smaller as rates increased above 150 pounds. The yield at the 400-pound rate was reduced the first year of the study, probably because of either a calcium or magnesium deficiency.

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Table.--Effects of Rates of Nitrogen on Yield of Corn Grown for Silage on a Cecil Sandy Loam.

Rate of N	Yield per acre, green weight				Dry Weight 3 yr. Avg.
	1960	1961	1962	Average	
lbs/A			tons		tons/A
0	12.4	9.0	11.3	10.9	3.1
50	15.8	14.5	13.0	14.4	4.0
100	15.4	16.9	13.8	15.4	4.3
150	19.5	21.3	16.2	19.0	5.3
200	19.3	20.8	18.7	19.6	5.5
300	20.4	22.4	18.8	20.5	5.7
400	17.0	25.4	23.2	21.9	6.1

L.S.D.
.05 = 3.9 tons

Nitrogen deficiency symptoms were noted each year at all N rates up to 100 pounds. However, the deficiency tended to become more pronounced with successive cropping, and by the third year, corn receiving N rates as high as 150 pounds was noticeably nitrogen deficient.

Soil tests reflected removals of potassium from the soil in amounts equal to that found in the crop.

Ga. Expt. Sta., Experiment, Ga.

90. Devine, J. R., and Holmes, M. R. J. FIELD EXPERIMENTS ON THE VALUE OF UREA AS A FERTILIZER FOR BARLEY, SUGAR BEET, POTATOES, WINTER WHEAT, AND GRASSLAND IN GREAT BRITAIN. J. Agr. Sci. 61: 391-396. 1963.

Urea containing less than 1 percent biuret was compared with ammonium nitrate in field experiments on barley, sugar beet, winter wheat, and grassland, and with ammonium sulphate on potatoes, in various parts of Great Britain in the years 1957-61. The authors concluded that:

1. When broadcast on the seed-bed for barley at rates supplying 25-45 lb./A. of nitrogen in 25 experiments, urea and ammoniun nitrate gave similar mean increases in grain yield on acid soils, while on alkaline soils urea gave smaller increases than ammonium nitrate. The relative effect of the two sources was similar on light and heavy soils and in the east and west of the country.
2. When broadcast on the seed-bed for sugar beet at 50-60 lb/A. of nitrogen in 19 experiments, mostly on alkaline soils, no difference was detected between the mean increases in yield of sugar and tops from urea and from ammonium nitrate.
3. In 22 experiments on potatoes, urea gave slightly smaller mean increases in yield of tubers than those from ammonium sulphate when applied at 40-60 lb./A. of nitrogen, with a larger difference at 80-120 lb./A. No influence of soil pH, soil texture, region of the country, or method of application was detected.

4. When broadcast as spring top dressings in 17 experiments on winter wheat, at rates supplying 34-45 lb./A. of nitrogen, urea and ammonium nitrate gave similar mean increases in yield of grain.
5. When broadcast as single top dressings for grassland at rates supplying 30-100 lb./A. of nitrogen in 53 experiments, urea gave a smaller mean increase in yield than ammonium nitrate. This inferiority appeared to be more marked on alkaline soils (especially on those with a high calcium carbonate content) than on acid soils or light soils.
6. On all crops, urea gave a significantly lower yield than the other source in a proportion of experiments (28 out of 136), and in some individual experiments urea was only one-half to two-thirds as effective in increasing yield. Urea gave a significantly higher yield in four experiments only, two on potatoes and two on wheat.

Levington Res. Sta., Ipswich, England.

91. Jones, W. F., Lancaster, J. D., Walton, L. B., Coats, R. E., and Hurt, B. C. UREA AND UREA-AMMONIUM NITRATE SOLUTIONS AS SUMMER PASTURE NITROGEN SOURCES. Miss. Farm Res. 26(10): 6. 1963.

Field experiments to evaluate solid urea and urea-ammonium nitrate solutions as sources of nitrogen for topdressing permanent summer-grass pastures have been conducted for 3 years by the Mississippi Experiment Station. Neither solid urea nor the urea-ammoniun nitrate solutions was as effective as solid ammonium nitrate.

Based on yield response and nitrogen uptake, solid urea was approximately 72 percent as effective as ammonium nitrate when applied in May; however, urea applied in June was about equal to ammonium nitrate. When made in May, applications of urea-ammonium nitrate solutions were only 55 percent as effective as ammonium nitrate. Urea-ammonium nitrate solutions applied in June were inferior to ammonium nitrate.

Based on yield and nitrogen recovery, urea-ammoniun nitrate solutions were equally effective when sprayed on the grass as when dribbled on it. Such burning of the foliage as occurred did not appear to influence yields.

Agr. Expt. Sta., Miss. State U., State College, Miss.

92. Seatz, L. F., and Sterges, A. J. CORN RESPONSE TO TIME AND RATE OF PHOSPHORUS APPLICATIONS. Soil Sci. Soc. Amer. Proc. 27: 669-670. 1963.

A greenhouse experiment was conducted to study the effects of rate and time of P applications on the growth and P uptake of corn. Different initial rates of P were applied and supplementary P was applied to make all treatments equal to the highest initial rate of 105 pounds P per acre. These supplementary applications were made to one set of each initial treatment at weekly intervals for 7 weeks after planting.

In most cases, the yields was lower if the supplementary P was not applied within 4 weeks after planting. The higher the initial rate of P the longer, the supplementary application could be delayed without yield reduction. In most instances, the total P uptake was greatest when the supplemental P was applied 5 or more weeks after planting.

A critical period probably exists in the development of corn before which P must be available if it is to increase plant growth. If P becomes available after this critical period, it will be absorbed by the plant and will be reflected in a higher percentage P composition.

Tenn. Agr. Expt. Sta., Knoxville, Tenn.

93. Wells, J. P., and Keogh, J. L. FERTILIZER STUDIES ON WHEAT AND OATS FOR GRAIN PRODUCTION. Ark. Agr. Expt. Sta. B. 677, 23 pp. 1963.

Small grain fertility tests were conducted during several years in eastern Arkansas to determine the response of wheat and oats to rate and timing of fertilization. In nearly every test, the application of nitrogen increased the grain yield. Phosphorus and potash often failed to increase yield when applied in either fall or spring.

Nitrogen was sucessfully applied in fall, spring, or as a split application in both fall and spring at the Southeast Branch Experiment Station for both wheat and oats in a 3-year experiment. Splitting the application did not result in increased yields. Caution should be exercised in fall application of high rates of nitrogen due to the possibility of winter kill.

The percent of nitrogen in both wheat and oat grain was increased by higher rates of nitrogen.

Oats and wheat were fertilized at Stuttgart as late as April 15 in 1960 without decrease in efficiency of nitrogen. The same was true for wheat grown at Keiser in a 2-year test during 1959-60 and 1960-61. Delaying the fertilizer application beyond April 15 resulted in depressed yields and sometimes green heads in the grain at harvest time.

Agr. Expt. Sta., U. Ark., Fayetteville, Ark.

94. Simmons, G. D., and Lynd, J. Q. EFFECTS OF FERTILIZATION AND CHEMICAL WEED CONTROL ON ESTABLISHMENT AND SURVIVAL OF NK-37 AND MIDLAND BERMUDAGRASS. Okla. State U. Expt. Sta. Proc. Ser. P-465, 33 pp. 1963.

The effect of fertilization on winter survival of NK-37 and the influence of fertilization and chemical weed control on establishment of NK-37 and Midland varieties of Bermudagrasses were determined. A survey of the survival percentage of NK-37 was conducted in various counties to evaluate the feasibility of using it as a permanent pasture grass in Oklahoma.

The field of study was conducted on a Kirkland 1 soil at Ardmore. Fertilization consisted of a banded application of 40 pounds of nitrogen, $17\frac{1}{2}$ pounds of phosphorus (P), and 33 pounds of potassium (K), plus an annual topdress application of 40 pounds of nitrogen as NH_4NO_3.

Diuron and 2,4-D were used for weed control treatments on the Midland and 2,4-D was used on the NK-37. The observation period began April 18, 1960, and was concluded August 31, 1962.

Midland diuron-treated plots had the lowest weed population and a significantly higher percentage of ground cover. Winter survival of Midland sprigs was not influenced by fertility or pre-emergence weed control treatments.

Fertilization significantly increased stand and winter survival of NK-37 with no differences in survival apparent from 2,4-D application.

Nitrogen and potassium content of NK-37 and Midland was significantly increased by fertilization with 400 pounds per acre of 10-10-10 at planting with an annual topdressing of 40 pounds N as ammonium nitrate.

Stand reduction of NK-37 by winterkill regardless of fertilization treatments was reported in 31 counties. Winter injury was most severe in northern Oklahoma.

Tables.

Okla. State U. Expt. Sta., Stillwater, Okla.

95. Elrod, J. M. ALFALFA FERTILIZER EXPERIMENTS. Ga. Agr. Expt. Sta., Mimeo Ser. N. S. 187, 22 pp. 1963.

The results of the experiments indicated that alfalfa hay can be produced successfully and profitably in Georgia when fertilized and managed properly.

Lime was essential for securing and maintaining a stand of alfalfa. The amount applied should be based on a soil test, and should be sufficient to produce a pH of 6.5 to 7.0.

Nitrogen treatments were detrimental to the yield of alfalfa.

Molybdenum did not increase the yield of alfalfa significantly. It had no beneficial effect when lime, phosphorus, and potassium were present in adequate amounts.

Borax was beneficial at 10 or 20 pounds per acre annually, but 40 pounds per acre depressed yields.

Phosphorus produced the most outstanding yield response. It should be applied liberally prior to seeding for establishment and maintaining the stand through the first winter. Phosphate should be applied annually at the rate of 80 to 100 pounds per acre of P_2O_5 in order to produce optimum yields.

Potassium is required in larger amounts than any other nutrient by alfalfa. However, the response to potash was not as marked as it was to phosphate due to the much larger amount of native potassium in the soil. Annual applications of 80 to 100 pounds per acre of K_2O together with the native potash should be adequate for maintaining stands and producing profitable yields.

Deep placement of fertilizer showed no beneficial effect. Higher yields of hay were obtained when the fertilizer was mixed with the soil by harrowing than when it was plowed in 8 inches deep or placed 16 inches deep with special equipment. Top-dressing annual applications were quite satisfactory.

The stand of alfalfa declined gradually even on the best fertilized plots. Some of the causes of loss of stand were: Heaving during severe freezes; crown rot; black stem; and other diseases.

Ga. Agr. Expt. Sta., U. Ga. Col. Agr., Experiment, Ga.

96. Jackson, T. L., and McDermid, J. T. EFFECT OF METHOD OF PHOSPHORUS APPLICATION ON ALFALFA GROWN ON A WILLAMETTE VALLEY "RED HILL" SOIL. Oreg. Agr. Expt. Sta. Tech. B. 74, 15 pp. 1963.

An experiment was established in 1957 to evaluate the effect of applications of lime and rate, time, and method of phosphorus application on the yield and P content of alfalfa when grown on a reddish brown lateritic ("Red Hill") soil in the Willamette Valley. Rates of 2 and 6 tons of lime/A. were applied before establishment. Applying all of the P at or before planting was compared with annual applications of P. Rates of 60, 180, and 360 pounds of phosphate (P_2O_5)/A. (26, 79, and 157 pounds phosphorus, P/A.) were applied during the 3-year period.

Small, but significant, responses were measured from application of P. The following conclusions were drawn:

1. There was a marked benefit on seedling vigor and stand establishment from banding P 1 inch below the seed at planting.
2. Band and broadcast applications of P at planting time produced the same yield of hay after the stand became established.

3. Annual applications of P were equal to or better than applying all of the P at planting time after the first year of hay yields.
4. The 6-ton rate of lime did not increase the availability of P over the 2-ton rate of lime.

Agr. Expt. Sta., Oreg. State U., Corvallis, Oreg.

97. Schmehl, W. R., and Romsdal, S. D. MATERIALS AND METHOD OF APPLICATION OF PHOSPHATE FOR ALFALFA IN COLORADO. Colo. Agr. Expt. Sta. Tech. B. 74, 25 pp. 1963.

Field experiments were conducted in the Arkansas Valley and in northeastern Colorado to study the relative effectiveness of various phosphate fertilizers and methods of application of phosphate for alfalfa grown under irrigation. The soils were low in available phosphorus, and fertilizer was applied at rates of 75 and 300 pounds P_2O_5 per acre. The phosphate materials tested were: Concentrated superphosphate; calcium metaphosphate; ammonium metaphosphate; dicalcium phosphate; and a calcined high-alumina phosphate ore. Methods of application of phosphate fertilizer were: (1) Plow down; (2) disk; (3) one-half disk and one-half plow down; and (4) broadcast after seeding. Phosphate materials were tested with the plow-down method of application. Methods of fertilizer application were studied with concentrated superphosphate.

There were generally only small differences among phosphate materials when evaluated on the basis of yield and total phosphorus content of the crop.

Based on the average for all experiments, the plow-down, disk, and broadcast methods of application were nearly equally effective.

A single 300-pound application of P_2O_5 applied at the time of seeding was equal to or slightly superior to four applications of 75 pounds P_2O_5 per acre.

The recovery of applied phosphate ranged from 38 to 59 percent for the 75-pound rate, and 26 to 29 percent for the 300-pound rate.

The application of 300 pounds P_2O_5 per acre was required to supply the phosphorus requirements of the nurse crop and 3 or 4 years of alfalfa.

The average phosphorus content of the hay was 0.174, 0.196, and 0.232 percent P for the 0, 75, and 300-pound P_2O_5 rates, respectively. The first cutting of hay was lowest and the second generally highest in phosphorus content.

Agr. Expt. Sta., Colo. State U., Fort Collins, Colo.

98. Lutz, J. A., Jr., Camper, H. M., Jones, G. D., and Carter, M. T. FERTILIZER PLACEMENT EFFECTS ON STAND, GROWTH, MATURITY, AND YIELD OF CORN. Va. Agr. Expt. Sta. B. 549, 40 pp. 1963.

The individual and combined effects of varying rates, ratios, and placement of nitrogen (N), phosphate (P_2O_5), and potash (K_2O) on the stand, growth, maturity, and yield of corn were measured at a number of locations in Virginia from 1958-61. Placement included broadcast, banding near the seed, banding in contact with seed, and application with a split-boot fertilizer attachment on the corn planter.

In one series of experiments, the fertilizer was applied by hand. The sources of nitrogen, phosphate, and potash were ammonium nitrate, concentrated superphosphate, and muriate of potash, respectively. In the other series, a commercial 10-10-10 fertilizer was

used. All fertilizer, except that broadcast, was applied when the corn was planted with a 2-row planter. The following conclusions were made:

1. The amount of fertilizer that can safely be applied in contact with the seed depends on the amount of rainfall just prior to and immediately after planting corn. Because of the uncertainty of weather, not over 20 lbs. per acre each of nitrogen and potash should be applied in contact. Since phosphate promotes early growth, it may be desirable to use a 1:2:1 or a 1:4:2 ratio fertilizer in the row.
2. During periods of moisture stress, nitrogen caused a greater reduction in stand than did potash.
3. When moisture was limited during the germination period, stand and yield were generally best when none of the fertilizer, or only the phosphate, was applied in contact.
4. The contact placement of 30 lbs. per acre each of nitrogen, phosphate, and potash seriously reduced the stand and yield if rainfall was inadequate during the planting season.
5. Serious injury to the stand resulted during dry periods when the fertilizer was applied in a split-boot, which indicates that the separation of seed and fertilizer was not 100 percent effective.
6. Large amounts of nitrogen and/or potash in contact with the seed may not only reduce the stand and slow emergence and growth, but may delay silking and maturity.
7. Inadequate moisture after emergence may reduce the stand if the seedling comes in contact with large amounts of fertilizer.

Va. Polytech. Inst., Agr. Expt. Sta., Blacksburg, Va.

99. Grava, J., and Halverson, M. LIMING MINNESOTA SOILS. Minn. Agr. Ext. Serv. Ext. Folder 210, 8 pp. Rev. 1963.

Agricultural lime is any material containing calcium or calcium and magnesium that, when properly applied, neutralizes soil acidity. Although gypsum contains calcium it is not a liming material because it does not correct soil acidity.

The benefits of liming are: (1) Furnishes calcium and magnesium for plant growth; (2) makes nitrogen and phosphorus more available to growing plants; (3) promotes the growth of favorable soil bacteria in acid soils; (4) prevents soil acids, aluminum, manganese, and iron from becoming toxic to plants; (5) improves the physical conditions of many soils by promoting a crumblike structure; (6) may help cut down on soil and water losses by improving soil tilth; and (7) lessens the possibility of insect and disease damage by promoting vigorous plant growth.

Two things determine the value of agricultural liming materials--purity and fineness of grinding. Pure calcium carbonate is used as a standard for other liming materials. The purity or the neutralizing value of a liming material is expressed in terms of its calcium carbonate equivalent (C.C.E.). Pure calcium carbonate has a C.C.E. of 100 percent. A limestone made up of 95 percent calcium carbonate and 5 percent sand and clay impurities has a C.C.E. of 95 percent. Limestone sold to Minnesota farmers generally varies from 80 to 98 percent C.C.E.

Table 6. Equivalent amounts of liming materials

Material	Amount
Ground agricultural limestone	1 ton
Marl	2 cubic yards
Carbide refuse lime	1 cubic yard
Water-softening process lime	2 cubic yards
Papermill refuse lime	2 cubic yards
Sugar beet refuse lime	2 cubic yards
Blast furnace slag	1 ton
Limestone sludge	1 ton
Eggshells	1 ton
Hydrated lime (1,400 pounds)	3/4 ton

U. Minn., Agr. Ext. Serv., St. Paul, Minn.

100. Tietjen, C. THE PORTION OF NITROGEN IN ORGANIC MANURES WHICH HAS AN EFFECT ON YIELD. Zeitschrift fur Acker- und Pflanzenbau 117(1): 55-76. 1963. (From English Summary)

From 1954-61 the yields of grain and straw from oats grown in 1 year pot experiments were used to determine the amount of nitrogen in various organic manures which had an effect on yield by employing the Mitscherlich equation log (A--y) = log A--c(x + b).

Graduated mineral nitrogen manuring was compared with 59 doses of 42 organic manure variants. The range of variation was from 129 to -20 percent. The mean value for the solid manurial variants in farmyard or straw manures amounted to 12 percent, while for the liquid variants, the mean value was 45 percent. For variants obtained from converted domestic wastes, the liquid forms used showed the higher values.

The extent to which reciprocal reactions between organic manures and increasing doses of mineral nitrogen have an influence on the portion of nitrogen which affects the yield was expressed through the quotients obtained from:

$$\frac{\text{increase of effective nitrogen}}{\text{amount of mineral nitrogen manuring}}$$

Taking the whole of the tested variants there was a negative correlation between the portion of effective nitrogen and the ratio of organic matter to nitrogen. This was also true for the groups of liquid manures; there was no correlation at all for the 15 solid variants.

With four variants from the same raw material with various C/N values, increasing C/N values a given level of yield required an increasing quantity of N. For increasing yield, the closer the C/N ratio, the greater was the N requirement.

Aus dem Institut für Humuswirtschaft der Forschungsanstalt für Landwirtschaft, Braunschweig - Volkenrode, Germany.

101. Midgley, A. R. WHEY AND WOOD BARK WASTES MAKE FERTILE COMPOST. Vt. Farm & Home Sci. 6(2): 4-5. 1963.

Whey is a by-product of cheese. Bark is a by-product in the production of wood pulp and lumber. Disposing of these two wastes frequently creates problems--but combine them and they make fertile compost.

Whey is a rather bulky by-product. From every pound of cheese about 9 pounds of whey are produced--or a total of about 290 million pounds a year in Vermont.

Bark from trees is a large by-product in the production of wood and pulp. Even with large trees, about 12 to 14 percent is bark. Disposing of bark is a different and much less difficult problem than that of whey.

In laboratory and greenhouse trials at the University of Vermont, six different kinds of air-dried bark were treated with whey. After most of the whey had decomposed and evaporated, more was added. This was repeated until a total $7\frac{1}{2}$ acre-inches had been applied. After the raw bark has received several applications of whey, it lost its identity and becomes dark in color. Finally an excellent compost was produced.

There was a marked increase in alkalinity when bark and whey decomposed together. Both are very acid (about pH 4.0). After decomposition, the carbonic-acid evaporated into the air and was lost, but the alkaline minerals remained. In the tests with soft maple, spruce, and hemlock, the pH increased from 4.3 to over 8.0.

The nitrogen content also increased, but not in proportion to the amount of protein nitrogen added in the whey. Large amounts of ammonia-nitrogen was lost into the air during the later stages of decomposition when the bark becomes alkaline.

A striking increase in potash and phosphorus content took place. For the spruce-hemlock mixture the increases in potash and phosphorus were 56.72 and 36.18 pounds in a ton of whey-treated dry bark.

U. Vt., Ext. Serv. and Expt. Sta., Burlington, Vt.

102. Warden, W. K. HANDLING AND DISPOSING OF POULTRY MANURE. Mich. State U., Coop. Ext. Serv. Ext. Folder F-323, 4 pp. 1963.

Economical poultry manure disposal involves removal of the material at low cost with a minimum of labor. For the most part, poultry manure accumulates in dropping pits of one sort or another and is removed periodically for spreading on fields. Most existing systems are ineffective in removing flies, odors, rodents, and disease organisms.

Methods that appear promising for improving handling and disposal of poultry manure are: (1) Both inside and outside lagooning; (2) drying and pelleting wet manure in a centrally located drying plant; (3) drying by bacterial action; and (4) drying by electrical charge.

A discussion of each of these methods was given. Each of these systems may prove practical depending on research and development work in the next few years. The time is fast approaching when a practical, workable method must be developed particularly for commercial poultrymen on a limited amount of land.

Coop. Ext. Serv., Mich. State U., East Lansing, Mich.

103. Toth, S. J. IS DRIED POULTRY MANURE VALUABLE FOR VEGETABLES? N.J. Agr. 45(5): 5-6. 1963.

More than 500,000 tons of industrial organic wastes are produced in New Jersey annually, approximately 50 percent of which consists of manure and bedding from the poultry industry.

The most logical means of disposal is to return the wastes to the soil and thereby improve its organic matter status and its ability to supply plant nutrient elements for the growing crop. An alternative method of disposal is to process the manure and sell it.

In the southern part of Monmouth and the northern parts of Ocean counties, the principal bedding for poultry is sugar cane bagasse, which as droppings are added to it may build

up to a depth of from 6 to 10 inches or more prior to its removal. The accumulated bedding plus droppings contains between 30 and 40 percent moisture when removed from the poultry houses.

The agricultural value of artificially dried poultry manure plus bedding was determined when used as an amendment to vegetable crops.

A large batch of dried manure was obtained for use in the field study. Table (1) presents an analysis of a representative sample.

Table (1)

Total N =	3.45%
Water soluble N =	2.32%
Water insoluble N =	1.13%
Total P_2O_5 =	7.21%
Available P_2O_5 =	4.32%
Total K_2O =	1.80%
Water soluble K_2O =	1.71%
Organic matter =	66.8%
Total Ca =	6.05%
pH =	7.00%

This sample of manure can be considered as a 3-4-2 fertilizer. A ton of manure contained approximately 1300 pounds of organic matter and 300 pounds of calcium carbonate. The lime originates from the calcitic grit used in the poultry industry.

Field tests conducted at the College Farm in 1960 compared the value of poultry manure alone, or reinforced with extra potash, with 5-10-10 fertilizer. The test crops were snapbeans and sweet corn. In 1961, the residual value of the poultry manure plus bedding was compared with fertilizer. The test crop was white potatoes. No amendments were added to the test plots in 1961. The results of the 2-year study are presented in table (2).

Table (2)

Treatment	Yields--1960 (Tons an acre)		Yields - 1961 (Bu. an acre)
	Snapbeans	Sweet corn	White potatoes
Nothing	4.5	3.1	145
1 ton poultry manure	6.2	4.1	208
2 tons poultry manure	6.3	5.4	220
3 tons poultry manure	6.5	5.7	220
5-10-10 to 1 ton poultry manure*	6.1	6.1	183
5-10-10 to 2 tons poultry manure**	6.8	6.4	185
1 ton poultry manure + K_2O***	5.4	4.2	209
2 tons poultry manure + K_2O***	5.4	5.3	209

*Based on N content of manure (1200 lbs. 5-10-10).

**Based on N content of manure (2400 lbs. 5-10-10).

***Extra potash based on difference between potash content of manure and 1200 or 2400 lbs. of 5-10-10 fertilizer.

Col. Agr., Rutgers - the State U., New Brunswick, N.J.

104. Perkins, H. F. RESIDUAL EFFECT OF BROILER MANURE ON CORN PRODUCTION IS HIGHER YIELDS. Ga. Agr. Res. 5(1): 10-12. 1963.

An investigation was established in 1959 on Cecil sl having a soil pH value of 6.7. Differential treatments consisted of 0, 4, 8, 12, and 16 tons of broilerhouse manure having an analysis of 22.3 percent moisture, 1.84 percent N, 1.07 percent P_2O_5, and 1.66 percent K_2O. The manure treatments were broadcast on March 3 and immediately turned to a depth of approximately 8 inches with a moldboard plow. An additional treatment consisted of side-dressing with 4 tons of manure when the corn was about 10 inches in height.

Two rates of commercial fertilizer consisting of 300 and 600 pounds of 4-12-12 and 40 and 80 pounds of nitrogen, respectively, were compared. The 4-12-12 was applied in the drill at planting and nitrogen was applied as a side-dressing when plants were approximately 10 inches in height. Manure and fertilizer treatments were made in 1959 only.

Each year the experimental area was turned with a moldboard plow and disked prior to seeding Dixie 82 corn during the first 2 weeks of May. Corn was thinned to a population of 12,000 plants per acre and cultivated twice during each growing season.

The residual effect of all rates of manure in 1960 resulted in significantly higher corn yields than yields obtained from the untreated plot (Table 1). Yields were directly related to the amount of manure applied in 1959. Rainfall in 1960 was adequate during the growing season. Residual effects of the 4-ton-per-acre rate of manure had disappeared by 1961, but the influence of the 8, 12, and 16 tons was still evident.

The low yields in 1962 were attributed to adverse weather conditions. Yields of corn treated with commercial fertilizers were not significantly greater than check plots after the initial year of application.

Table 1. The Effect of Broiler Manure and Mineral Fertilizer on Yield of Corn Grown on Cecil Sandy Loam. Athens, Georgia

Treatments 1959 only	Shelled grain 15.5 percent moisture				
	1959	1960	1961	1962	Total
(per acre)	(bu/A)	(bu/A)	(bu/A)	(bu/A)	(bu/A)
Check	26.4	20.0	24.8	7.9	80.1
4 tons manure	58.5	42.1	30.8	13.3	144.7
8 tons manure	50.8	56.6	48.6	20.2	176.2
12 tons manure	48.1	80.1	57.1	20.1	205.4
16 tons manure	50.7	90.0	62.8	19.8	223.3
4 tons manure (sidedress)	49.1	41.4	24.2	12.0	127.7
300 lbs. 4-12-12 + 40 lbs. N	45.5	23.2	25.8	8.2	102.7
600 lbs. 4-12-12 + 80 lbs. N	55.5	28.8	29.1	8.2	121.2
LSD@ 0.05	16.1	12.8	10.9	N.S.	----

Table 2. Initial and Residual Value of Broiler Manure for Corn Production on Cecil Sandy Loam.

Treatment tons/A.	Per acre value of grain @ $1.25/bu. by year[a]					Total value manure/ton
	1959	1960	1961	1962	Total	
4	$42.39	$27.62	$ 7.50	$ 6.75	$ 83.74	$20.93
8	30.50	45.75	29.75	15.37	121.37	15.17
12	27.12	75.12	40.37	15.15	157.76	13.15
16	29.37	87.50	47.50	17.70	182.07	11.38

[a]Value above that of check plot yield.

The author concluded that:

1. Broiler manure at rates of 4 or more tons per acre significantly increased corn yields the year of application.
2. Residual effects of broiler manure were observed in yields of corn the second year after application for the 4-ton-per-acre rate and the third year for rates of 8 tons per acre and above.
3. The net returns for 4, 8, 12, and 16 tons of broiler manure were approximately 83, 121, 157, and 182 dollars per acre, respectively, for a 4-year period.
4. The value of manure per ton was inversely proportional to the rate of application.
5. Broiler manure tended to reduce soil pH values but increased the level of soil phosphorus and potassium.

Ga. Agr. Expt. Sta., U. Ga., Col. Agr., Athens, Ga.

105. Capstick, D. F., and Hinkle, D. A. ECONOMICS OF CORN FERTILIZATION. Ark. Farm Res. 12(6): 3. 1963.

Tests indicate that corn responds only to nitrogen fertilization on some Arkansas soils. Estimated yields of irrigated corn at the Southeast Branch Station, Kelso, Ark., increased with increasing rates of nitrogen up to an 82-pound rate in 1960 and a 119-pound rate in 1961. These tests were conducted on Portland sil and Hebert sil loam soils. Actual test data were obtained for six nitrogen rates - 0, 20, 40, 60, 80, and 100 pounds per acre.

Estimated yields were derived by production function analysis employing the least squares method of regression (Figure 1). The yield response function used indicates that 97 percent of the variability in test yields for each of the 2 years was explained by nitrogen input.

With the prices given, nitrogen could have resulted in an increase in net returns by as much as $19.60 per acre in 1960 and $38.95 in 1961. This was equal to an average of $29.27 per year or a total of $58.55 for the 2 years.

Because factors other than nitrogen also influenced yields, it was not possible to predict accurately beforehand the economic optimum amount of nitrogen to apply each year even under given price conditions. Therefore, recommendations must be based on an anticipated average response. Based on the data, an average rate of 80 pounds of nitrogen each year would have proved most profitable. This would have been a little more than the optimum amount for 1960 and less than optimum for 1961. Yet the total increase in net returns would have amounted to $56.09, or only $1.23 per acre per year less than with the optimum rate each year.

The most profitable rate of nitrogen was not altogether insensitive to changes in the ratio of corn value and nitrogen cost. For example, over the range of 8 to 20 cents per pound for nitrogen and $0.90 to $1.50 for corn, the optimum rate of nitrogen, based on the yields obtained in 1960-61, varied from a low of 64 to a high of 85 pounds per acre (Figure 2).

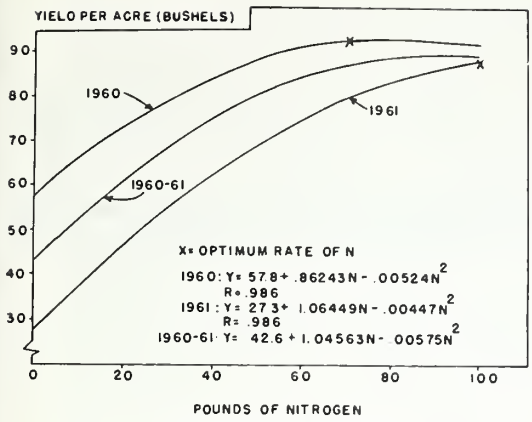

Fig. 1. Corn Yield Response Curves for Nitrogen Fertilization

Source: "Effect of nitrogen level on corn production," Ark. Farm Research Vol. XI, No. 2, 1962.

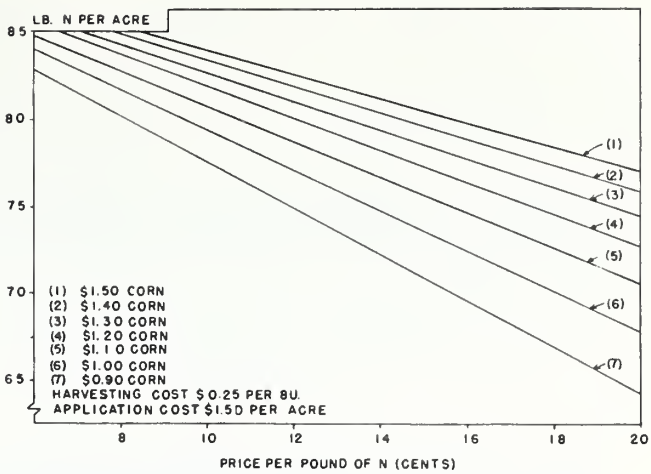

Fig. 2. Most Profitable Rates of Nitrogen at Alternative Prices for Corn and Nitrogen, 1960-61 Average Response

U. Ark., Agr. Expt. Sta., Fayetteville, Ark.

Salinity and Alkali Problems

SEE ALSO 15, 18, 43, 90, 169.

106. Bower, C. A., and Maasland, M. SODIUM HAZARD OF PUNJAB GROUND WATERS. West Pakistan Engin. Conf. Proc. 1963: 49-61. 1963.

Carbonates in irrigation waters may precipitate in soils as $CaCO_3$, and the precipitation enhances the tendency of the soil to accumulate exchangeable Na from the water. The fraction of carbonate applied in irrigation water which precipitates in soil is variable and is influenced by several factors including the relative and absolute concentrations of Ca+Mg and CO_3+HCO_3 in the water, the Ca+Mg, CO_2, and pH status of the soil, and the degree to which the ionic concentrations of the soil solution increase owing to loss of water by evapotranspiration. The extent to which exchangeable Na accumulates in soils irrigated with high carbonate waters depends upon the SAR of the water as well as upon the fraction of applied carbonate that precipitates as $CaCO_3$. A steady state condition with respect to accumulation of exchangeable Na may not be attained short of nearly complete saturation of the exchange complex for the following reason: As exchangeable Na accumulates, the pH of the soil usually increases, and this enhances the precipitation of $CaCO_3$. With additional precipitation of $CaCO_3$, the proportion of Na in the soil solution and on the exchange complex increases further, leading to an additional increase in pH and a repetition of the process.

For evaluating the usability of waters containing CO_3+HCO_3 in excess of Ca+Mg, the "residual Na_2CO_3" concept of Eaton seems to have some merit. However, for waters containing high amounts of carbonates but no "residual Na_2CO_3" the concept is unsatisfactory. The empirical equation--$ESP = 2SAR + 2SAR(8.4 - pH_c)$ involving the SAR and a modified Langelier index appears to be reasonably satisfactory for predicting the Na hazard of high carbonate waters regardless of whether they contain "residual Na_2CO_3".

If the 74 tubewell waters studied are representative of a substantial fraction of Punjab ground waters, then by either the "residual Na_2CO_3" concept or the empirical equation, a potential sodium hazard is involved in the use of many of these waters for irrigation. If some of the ground waters are used as the sole source of water for irrigation, the soil will accumulate injurious amounts of exchangeable Na with time. If hazardous ground water is used to supplement surface water for irrigation by dilution or by alternate use, no excessive accumulation of exchangeable Na may occur. Rainfall, where appreciable and effective, may also be expected to have a retarding effect on the accumulation of exchangeable Na from hazardous waters.

U.S. Salinity Lab., SWCRD, ARS, USDA, Riverside, Calif., 92502

Cover Crops and Green Manure Crops

SEE ALSO 70, 77.

107. Edwardson, J. R., Wells, H. D., and Forbes, I., Jr. BLUE LUPINES FOR GRAZING AND FOR SOIL IMPROVEMENT IN FLORIDA. Fla. Agr. Expt. Sta. C. S-146, 7 pp. 1963.

A "culture and care" publication on the growing of sweet varieties of blue lupines for forage and soil improvement and bitter varieties for soil improvement was given for Florida conditions.

Agr. Expt. Sta., U. Fla., Gainesville, Fla.

108. Long, O. H. and Overton, J. R. BUTTONCLOVER AS A GREEN MANURE CROP FOR COTTON. Tenn. Agr. Expt. Sta. B. 370, 9 pp. 1963.

Button clover (Medicago orbicularis) turned under as a green manure crop was about as effective as 50 to 60 pounds of nitrogen in increasing yields of cotton in two experiments.

On Pembroke sil in Lawrence County, Tenn., as a 5-year average, the yield of seed cotton was 1,231 pounds per acre where it was not fertilized with nitrogen, 1,618 pounds where cotton followed buttonclover, and 1,661 pounds where cotton was fertilized with nitrogen at a rate of 50 pounds of N per acre.

On Memphis sil at Jackson, Tenn., as a 4-year average, the yield of seed cotton was 1,760 pounds per acre where it was not fertilized with nitrogen, 2,559 pounds where cotton followed buttonclover, and 2,512 pounds where cotton was fertilized with nitrogen at a rate of 60 pounds of N per acre.

The yields reported do not include the years a buttonclover seed crop was produced. If these years were included, considerably more cotton was produced where it was grown every year and fertilized with nitrogen.

U. Tenn., Agr. Expt. Sta., Knoxville, Tenn.

SEE ALSO 2, 3, 6, 7, 11, 27, 37, 38, 39, 52, 75, 81, 84, 94, 98, 174, 175, 176, 239, 241, 252, 297.

109. Rosenberg, N. J., ed., and Colville, W. L., Drew, J. V., Myers, R. E., Reed, E. C., Schleusener, P. E., and Young, J. O. CLIMATIC ATLAS OF IRRIGATED REGIONS IN NEBRASKA: I. THE CLIMATE OF THE CENTRAL PLATTE VALLEY; PART A--WATER AND SOIL RESOURCES, SOLAR RADIATION, TEMPERATURE, THE GROWING SEASON AND PRECIPITATION. APPLICATIONS IN CROP SCHEDULING AND IRRIGATION. Nebr. Agr. Expt. Sta. Misc. P. 9, 75 pp. 1963.

Water resources of the Central Platte Valley are of high quality, dependable, and in ample supply to support irrigation agriculture. Ground water storage in the area ranges from 30 to 70 feet of water.

The important soils of the area were described as to their physiographic position, texture, depth, drainage, inherent fertility, and management problems. Extensive areas of excellent agricultural soils occur in the valley on broad terraces, bench lands, and nearly level bottom lands.

The annual supply and seasonal reliability of solar radiation in the valley was estimated through use of local and distant records. No climatic anomalies interrupt the natural seasonal progression of solar radiation. Data supplied have engineering as well as agricultural implications.

The wide annual range of temperatures within the Central Platte Valley is typical of a continental climate. Stations in this area differ very little in the maximum, minimum, and mean temperatures during any given year. However, differences from one growing season to another may be quite large and must be considered in planning agricultural enterprises. The winter seasons are more variable than the growing seasons.

Length of the growing season was determined through use of weather records and probabilities of any given duration for the growing season were presented. The nature of late spring and early fall frosts in the valley was established and the possibility of extending the length of the growing season through frost control measures was considered on a probability basis.

Normals of precipitation were given and the probability of occurrence of varying quantities of rainfall during any 1, 2, or 3 week period were presented. Two major peak periods and one period of depressed rainfall occurred during the growing season.

An important agricultural problem, crop scheduling was evaluated by means of the Growing Degree Day system. Because of the high degree of station to station uniformity in the temperature regime, normal and extreme monthly and daily Growing Degree Day accumulations, presented for three base temperatures, provide a ready reference for application of the system to crop scheduling.

Information pertinent to the design and operation of irrigation systems for two crops, based on experimental work and climatic data for the Central Platte Valley, indicates that workable and efficient irrigation systems can be easily fitted to conditions in the valley.

Tables, maps, and graphs.

U. Nebr., Col. Agr., Agr. Expt. Sta., Lincoln, Nebr.

110. Haynes, B. C., Jr. AUTOMATIC WEATHER STATION. Ga. Agr. Expt. Sta. Tech. B. N. S. 33. 25 pp. 1963.

An automatic weather station used at the University of Georgia was described and illustrated. The author concluded that:

1. An automatic weather station is a useful tool for the research scientist. It provides: (1) Research associated weather data in a form immediately available for computation or correlation; and (2) long time continuous record suitable for local evaluation of research work accomplished in other geographical areas.
2. Any suitable data-logging equipment is desirable for accumulation of research data in the following ways: (1) It relieves the researcher of the drudgery associated with manual observation of indicating equipment; (2) it does away with the necessity of transcribing voluminous data from printed chart record to useable form; (3) it eliminates unavoidable human error encountered in transcription of data from one form to another; and (4) it presents data in a form suitable for immediate machine analysis.
3. A tape punch output was recommended over a card punch output for use with unattended data-logging equipment. Use of card punch output for normally attended equipment was considered satisfactory depending upon the mode of input available on computer equipment.
4. For normal research application the use of a strip-chart recorder, with an analog to digital conversion, was considered more desirable than using digital voltmeter equipment. It may be desirable to observe changing conditions on a chart record while actually logging data in the form of punched tape or cards. For research applications involving rapidly changing conditions, it may be desirable to consider digital voltmeter equipment. One of the great advantages of using a strip-chart recorder was the availability of built-in point switching gear. By using this built-in selecting switch equipment, errors that might accrue from external switch-gear were prevented.
5. Linearization of the outputs of various modes of transducer inputs was not a problem with data-logging equipment of this type. Where it was possible to fabricate simple printed circuit bridge networks, which will linearize transducer output, this should be done. Where linearization of transducer outputs would involve complicated equipment it was advisable to log the data in non-linear form and linearize the logged data with computer equipment.

Ga. Agr. Expt. Sta., U. Ga. Col. Agr., Athens, Ga.

111. Brooker, D. B., and McQuigg, J. D. WEATHER ANALYSIS FOR CROP DRYING. Mo. Agr. Expt. Sta. Res. B. 837, 41 pp. 1963.

As research concerning crop drying has progressed, the need for detailed information regarding the effect of weather has become more and more apparent. The design of crop drying equipment, especially that type of equipment associated with in-storage drying, is dependent on expected weather conditions during the drying operation.

Results of an analysis of Columbia, Mo., weather data were given. The data were processed to determine and statistically analyze two variables associated with drying crops with in-storage drying equipment. The variables were: (1) The capacity that the air has to

receive and carry off moisture when forced through the stored crop; and (2) the temperature of the undried portion of the crop mass during the drying process.

Tables and charts.

U. Mo., Col. Agr., Agr. Expt. Sta., Columbia, Mo.

112. Jennings, A. H. MAXIMUM RECORDED UNITED STATES POINT RAINFALL; FOR 5 MINUTES TO 24 HOURS AT 296 FIRST-ORDER STATIONS. U.S. Dept. Comm., Weather Bur. Tech. Paper 2, 56 pp. $0.40 Rev. 1963.

Maximum rainfall amounts for 5, 10, 15, 30, and 60 minutes and for 2, 3, 6, 12, and 24 hours at 296 stations were shown in table form and on maps, one map for each duration. Maximum values were obtained by examination of precipitation data in published and unpublished tabulations and summaries. Maxima were selected for all Weather Bureau first-order stations, active or discontinued, having published excessive rainfall tabulations (5 to 180 minutes) for at least a 5-year period. In the original study, the minimum length of record was 10 years. The minimum was lowered to 5 years in order to include a relatively large number of stations that began measurements of excessive rainfalls for 5- to 180-minute durations about 1954.

For sale by Supt. Doc., U.S. Govt. Print. Off., Washington, D.C., 20402

113. Stauber, S., Decker, W. L., and Miller, F. INCIDENCE OF DROUTH CONDITIONS IN SOUTHEASTERN MISSOURI. Mo. Agr. Expt. Sta. Res. B. 836, 39 pp. 1963.

The weather-related variables which could be associated with the costs and returns of supplemental water application in a four-county area in southeastern Missouri were defined.

A method of evaluating the drouth incidence and the need for supplemental irrigation was used which takes into account the agronomic and climatic conditions which affect the amount of soil moisture available for use by the crop. The method involves computation of the daily available soil-moisture balances in the effective rooting zone of the crop. Daily minimum and maximum temperature values adjusted for the latitude of the geographic area were used to estimate the moisture losses through evapotranspiration from the soil-plant regime.

The climatological data necessary to compute daily soil-moisture balances were obtained from long-term weather records for stations in or adjacent to the study area. The daily soil-moisture balances were computed for a range of available soil-moisture bases adequate to encompass most soil-crop situations in the study area. Days during which soil-moisture was less than a minimum level considered necessary for optimum plant growth were designated as drouth-days. Frequency distributions were prepared of drouth day occurrences and of the number of water applications necessary to prevent their occurrence for selected time periods during the crop season. The drouth hazard of the area was characterized in two primary ways: (1) The expected frequency of occurrence of specified numbers of drouth-days; and (2) the expected frequency of need for water application to prevent potential drouth damage. Data dealing with the persistence of drouth periods also were presented.

The occurrence of drouth periods of apparently damaging intensities were quite common for most soil-crop conditions in the Delta during July and August.

771-426 O-65—5

Results of this study can be applied to agricultural problems dealing with drouth hazard in the following ways: (1) The method used to determine the occurrence of periods during which soil-moisture is nonoptimal for plant growth and can readily be adopted by farmers as a guide in scheduling water applications. (2) The results can be used as a basis for a comprehensive evaluation of the economic feasibility of supplemental irrigation. (3) Drouth-day information can aid in the interpretation of agronomic tests in which soil moisture is a variable affecting the results. And (4) a study of the drouth history of the area would allow the attachment of a probable recurrence value to the observed results. This information will aid in the solution of problems dealing with layout, design, capacity, and other engineering aspects of irrigation systems.

In short, the drouth-day concept offers a new approach to the study of weather-related problems encountered in agricultural production.

U. Mo., Col. Agr., Agr. Expt. Sta., Columbia, Mo.

114. Kuiper P. J. C. PRELIMINARY OBSERVATIONS ON THE EFFECT OF LIGHT INTENSITY, TEMPERATURE, AND WATER SUPPLY ON GROWTH AND TRANSPIRATION OF YOUNG BEET PLANTS UNDER CONTROLLED CONDITIONS. Mededelingen van de Landbouwhogeschool te Wageningen, Nederland 62 (7): 1-27, 1962.

Young beet plants were grown for a period of 6 weeks at different temperatures, light intensities, and irrigation regimes.

Transpiration and the vapor pressure deficit of the air were related by linear curves, the slopes of which depend on light intensity and water supply. After applying the MITSCHERLICH-equation to these results, a formula for the effect of light intensity, vapor pressure deficit of the air, and water supply was derived.

Leaf area showed a relation of the BLACKMAN-type with light intensity. The linear, temperature-independent part was due to a relation between total leaf area and light intensity, while the saturation levels were determined by temperature and water supply. Fresh weight of the shoot had a linear relation to leaf area, indicating an intimate relationship between the water content of the leaves and growth of the leaves.

The dry matter production of the shoot was affected by temperature, light intensity, and, to a smaller extent, by water supply. The effect of a factor was most pronounced under optimal conditions of the others. The gain in dry weight of the shoot was related to light intensity by curves of the MITSCHERLICH-type. The dry matter production of the roots increased exponentially with increase in light intensity, while no temperature effect was detectable. It was suggested that the sugar transport to the roots limits their dry matter production. Under high transpiration conditions, especially at high light intensity, a linear relation between transpiration and the gain in dry weight of the roots was observed, indicating limitation of dry matter of roots by the water uptake.

Under high transpiration conditions, the water requirement of the shoot (total water consumption/dry matter of shoot) decreased with decreasing water supply, while under lower transpiration conditions the levels of water requirement coincided with the values of vapor pressure deficit of the air.

The water requirement of the roots (total water consumption/dry matter of roots) increased considerably with decreasing water supply at high light intensities and at all temperatures.

Lab. Plant Physiol. Res., Agr. U., Wageningen, Netherlands.

115. Dethier, B. E., and Vittum, M. T. THE CLIMATE OF THE NORTHEAST: GROWING DEGREE DAYS. N.Y. State Agr. Expt. Sta. (Geneva) B. 802 (Northeast Region. Res. P.) 84 pp. 1963.

Growing degree days, sometimes called "heat units," "effective heat units," or "growth units," are an arithmetic accumulation of daily mean temperatures above a certain threshold temperature. They are a simple means of relating plant growth, development, and maturation to environmental air temperature. Different species of plants have different base or threshold temperatures below which they theoretically do not grow. At temperatures above this base or threshold value, the amount of plant growth is approximately proportional to the amount of heat and temperature accumulated. The base temperatures used in this bulletin, 40° and 50° F, correspond closely to the generally accepted values of the base temperatures for several economically important plants: Spring wheat, 37° to 40° F.; canning peas, 40° F.; oats, 43° F.; potatoes, 45° F.; and sweet corn, snap beans, lima beans, tomatoes, and field corn, 50° F.

The growing degree day value for any day is easily obtained by subtracting the appropriate base of threshold for the specific crop from the mean temperature.

The growing degree days, to any base, can be computed each day from daily temperatures, and can be accumulated over the course of the growing season. Negative values are ignored in summation of growing degree days.

The amount of plant growth is approximately proportional to the amount of heat or temperature accumulated above the base. For each species of plant, and for different varieties, maturity is reached when the growing degree days have accumulated to a certain sum. The various pea varieties, for example, require a range from about 1,200 to 1,800 growing degree days. This means of reckoning the time of maturity has been applied by the canning industry, to maintain an orderly supply for processing. The heat unit system is also helpful in selecting crop varieties appropriate to different farming areas and in scheduling the work of fruit orchards. Since insect emergence and development also respond to temperature, heat sums have been utilized to predict epidemic outbreaks of insects.

The application of growing degree days is a useful system but has two main flaws. It over simplifies the complex temperature response of plants, and it does not take into account the many other environmental factors affecting plant growth.

Tables, maps, graphs, and charts.

N.Y. State Agr. Expt. Sta., Geneva, N.Y.

116. Bingham, C. THE CLIMATE OF THE NORTHEAST: PROBABILITIES OF WEEKLY AVERAGES OF THE DAILY TEMPERATURE MAXIMUM, MINIMUM, AND RANGE. Conn. Agr. Expt. Sta. (New Haven) B. 659 (Northeast Region Res. P) 28 pp. 1963.

Information necessary to compute all probability levels of certain temperature varieties at all points in the northeastern region of the United States: New England, New York, Pennsylvania, New Jersey, Delaware, Maryland, and West Virginia was given. These temperature variates were the following: (1) The average of any seven consecutive values of the diurnal maximum temperature; (2) the average of any seven consecutive values of the diurnal minimum temperature; and (3) the average of any seven consecutive values of the diurnal temperature range. The maximum temperature, the minimum temperature, or the diurnal temperature range means these 7-day averages.

Tables, maps, and charts.

Conn. Agr. Expt. Sta., New Haven, Conn.

117. Baker, D. G., and Strub, J. H., Jr. CLIMATE OF MINNESOTA: II. THE AGRICULTURAL AND MINIMUM-TEMPERATURE-FREE SEASONS. Minn. Agr. Expt. Sta. Tech. B. 245, 32 pp. 1963.

Using crop phenology dates at 9 stations as the basic data, the commencement date and duration of agricultural seasons at 75 Minnesota stations were determined using minimum temperature occurrence probabilities. Minnesota's agricultural seasons were defined as follows:

1. Early spring begins when 20 percent or less of the minimum temperatures are 16° F. or lower. In early spring, cool season perennial crops begin to grow and cool season annuals are planted.
2. Late spring begins when less than 20 percent of the minimum temperatures are 32° F. or lower. In late spring, warm season crops are planted and cool season crops grow rapidly.
3. Summer begins when less than 10 percent of the miminum temperatures are 40° F. or lower. In summer, warm season crops grow rapidly and cool season annuals are harvested.
4. Early fall begins when more than 20 percent of the minimum temperatures are 40° F. or lower. In early fall, cool season crops are planted and warm season crops mature rapidly.
5. Late fall begins when more than 10 percent of the minimum temperatures are 32° F. or lower. In late fall, cool season crops grow rapidly and warm season annuals are harvested.
6. Winter begins when more than 20 percent of the minimum temperatures are 16° F. or lower. In winter crop plants are dormant.

These temperature-defined agricultural seasons may aid in establishing crop climatic boundaries and provide a guide for agricultural practices, especially planting and harvesting.

The probabilities of duration of selected minimum-temperature-free seasons were calculated. The duration probabilities may be useful in the long-term planning of agricultural and industrial activities dependent upon the minimum temperatures considered: 16°, 20°, 24°, 28°, 32°, 36°, 40°, and 50° F.

Tables and maps.

U. Minn., Agr. Expt. Sta., St. Paul, Minn.

118. Nash, A. J. A METHOD FOR EVALUATING THE EFFECTS OF TOPOGRAPHY ON THE SOIL WATER BALANCE. Forest Sci. 9(4): 413-422. 1963.

Average solar radiation values for the growing season for various slopes and aspects were used to compute the receipt of solar radiation as percentage differences from the amount received on a horizontal surface. These percentages were shown in graphic form and were used to correct potential evapotranspiration data in computing water balances by the Thornthwaite and Mather method. Water balances were computed for 21 combinations of slope and aspect, for three types of precipitation years--wet, normal, and dry--and for two soil moisture storage capacities--4 inches and 10 inches. The type of year was based on departures from a 10-year average obtained from weather records at one station in southern Missouri.

The water balances for a soil moisture storage of 4 inches, gave a soil moisture deficit of 2.93 inches on a north 50° slope in a normal year. In a dry year on a 50° west slope, the deficit amounted to 17.61 inches. For the 10-inch storage capacity, the deficit ranges from 1.40 inches to 12.61 inches for the same combination of slope, aspect, and type of year. A deficit of 0.08 inch occurred in 1 month of the growing season during a wet year.

The methods used may be applied to any locality when latitude and average monthly cloud cover for the growing season are taken into account.

U. Mo., Columbia, Mo.

Surface Soil Removal

SEE 72, 73.

Mulching

SEE 20.

PLANT MANAGEMENT

Pasture and Haylands

SEE ALSO 20, 26, 27, 28, 48, 49, 56, 58, 77, 90, 91, 94, 95, 96, 97, 107, 136, 137, 139, 140, 144, 216, 231, 237, 269.

119. Kehr, W. R., Conard, E. C., Alexander, M. A., and Owen, F. G. PERFORMANCE OF ALFALFAS UNDER FIVE MANAGEMENT SYSTEMS. Nebr. Agr. Expt. Sta. Res. B. 211, 28 pp. 1963.

Stands, forage yields, and other agronomic data on alfalfas of diverse origin or type were tested under five management systems at Lincoln, Neb.

Narrow-crowned and broad-crowned types were used. The management systems involved were: (1) Non-irrigated alfalfa-bromegrass tests continuously grazed with steers; (2) non-irrigated alfalfa-bromegrass tests cut for hay; (3) non-irrigated alfalfa-bromegrass tests rotationally grazed with sheep; (4) an irrigated alfalfa-bromegrass test rotationally grazed with dairy cattle; and (5) irrigated tests of alfalfas in pure stands cut for hay.

Differential stand establishment of alfalfas was observed in alfalfa-bromegrass tests. In general, poorest initial stands were obtained with alfalfas having the associated characteristics of high degree of spring and fall vegetative dormancy, semi-prostrate to prostrate growth habit, and slow rate of recovery after cutting.

Rank of alfalfas for persistence varied with the management system. Persistence of narrow-crowned alfalfas such as Buffalo, Du Puits, and Grimm varied greatly with the management system. Polycross progeny of clone 2703, experimental synthetics A169 and A224, and the varieties Nomad, Rhizoma, and Vernal, all broad-crowned types, gave superior persistence under the wide range of management systems.

Rank of alfalfas for forage yield varied with the management system. Forage yields of A225, Du Puits, Grimm, Ladak, and Rhizoma varied greatly with the management system. A169, Buffalo, Ranger, and Vernal produced well under the wide range of management systems.

Plant characteristics which contributed to the rank of alfalfas for stand or yield, or both, appeared to be crown type in the non-irrigated test continuously grazed with steers, and bacterial wilt reaction in the irrigated test rotationally grazed with dairy cattle.

No differences in palatability of alfalfas were detected during 2 years of evaluation with dairy cows.

U. Nebr., Col. Agr., Agr. Expt. Sta., Lincoln, Nebr.

120. Tovey, R. CONSUMPTIVE USE AND YIELD OF ALFALFA GROWN IN THE PRESENCE OF STATIC WATER TABLES. Nev. Agr. Expt. Sta. Tech. B. 232, 65 pp. 1963.

The short-term (weekly) consumptive use and yield of alfalfa grown on various soil types in the presence of static water tables and in the absence of a water table on well drained soils were given. Consideration was also given to the effect of plant growth stage on the consumptive use of alfalfa. Statistical methods were employed to determine whether the consumptive use and yield of alfalfa were affected by water table depth, soil texture, irrigation treatments, and other variables. Correlation coefficients relating plant growth stage, standard pan evaporation, and net radiation to consumptive use were calculated. Where applicable, prediction equations were formulated that can be used to estimate the consumptive use of alfalfa under the various conditions included in the experiment.

An installation of 63 lysimeters, 3 to 9 feet deep, was completed and stands of alfalfa were established in and around the tanks at the Field Laboratory near Reno in 1958. The short-term (weekly) consumptive use of alfalfa and related factors were measured during the 1959-61 growing seasons. The author concluded that:

1. Average seasonal yields of alfalfa from the lysimeters (7.2 tons per acre), the area surrounding them (7.3 tons per acre), and field plots (6.0 tons per acre), were an indication of the differences that exist between lysimeter and field data.
2. A three-season average of consumptive use and yield of alfalfa, disregarding soil textures, decreased consistently with increased water table depth for the nonirrigated treatment.
3. Consumptive use and yield for the drained, irrigated, and 8-foot water table nonirrigated treatments were almost identical.
4. Irrigated alfalfa yields were comparable for shallow or deep static water tables. Surface irrigation water requirements were less for the shallower water table treatments.
5. Seasonal plant growth and climatic factors governed alfalfa yield and affected ground-surface water requirements.
6. The nonirrigated alfalfa definitely showed the effects of static water table depth on the consumptive use and yield of alfalfa.
7. Alfalfa plants growing in the presence of static high water tables tended to use more water than would be expected in a well drained, irrigated field.
8. Peak consumptive use occurred when the alfalfa was at or approaching the one-tenth bloom stage and temperatures were high.
9. Measured peak weekly water requirements should be useful in determining adequate design criteria for irrigation and drainage systems.
10. Blaney-Criddle coefficients (seasonal) were higher (1-1/2 to 2 times) than 0.85 (average field value for alfalfa).
11. The alfalfa plants in the lysimeter showed good root development, with roots in the saturated zone and enlarged white rootlets extending below the water table level.

12. Analysis of variance indicated that the consumptive use and yield of alfalfa, grown under static water table conditions, were affected by water table depth, soil texture and irrigation treatment.
13. Highly significant correlations were found for weekly growth stage and consumptive use for all water table treatments. Cumulative weekly pan evaporation and consumptive use of alfalfa for crops showed highly significant relationships.
14. Regression or prediction equations calculated for weekly growth stage and standard pan evaporation versus consumptive use offered a comparatively satisfactory method of estimating short-term water requirements for alfalfa. Regression equations relating cumulative standard pan evaporation and consumptive use of alfalfa for crops gave a good estimation of crop and seasonal water requirements for all treatments.

Agr. Expt. Sta., Max C. Fleischmann Col. Agr., U. Nev., Reno, Nev.

121. Brown, B. A. ALFALFA VARIETIES AND THEIR MANAGEMENT. Conn. Agr. Expt. Sta. (Storrs) B. 376, 18 pp. 1963.

In the spring of 1956, 40 unnamed and eight named varieties of alfalfa were seeded on quadruplicated 5 X 16 foot plots. The stands and yields for two cuttings each season were determined for 5 years, 1957-61.

In 1957 and 1958, Du Puits had the best stands and largest yields among the 48 varieties. From 1959-61, it maintained the poorest stands and was among the lowest in yields due mostly to bacterial wilt and winter killing. Narragansett maintained fair stands and high yields through 1960 but in both respects was much inferior in 1961 to Atlantic and Vernal. Its decline in vigor was, at least, partly due to wilt. The Buffalo, Williamsburg, and Lahontin varieties decreased markedly in stands during the severe winter of 1958-59. Their yields were low during the last 3 years. They also showed symptoms of wilt. Ranger was between the best and poorest of the named varieties.

In mid-summer of 1958, 31 unnamed and 10 named varieties were seeded on 16 X 5 foot plots replicated five times. Most of these varieties were the same ones tested in the 1956 seeding and were managed in a similar manner.

Lahontin and Moapa failed to establish good stands and produced poorly throughout the 3 year period, 1959-61. Alfa, DuPuits and NK-501 had excellent stands and very high yields in 1959 but thinned rapidly with wilt in 1960 and yielded less than most of the other varieties in 1960 and 1961. Buffalo and Williamsburg maintained fair stands and yields but were inferior to Ranger. Atlantic and Vernal maintained better stands than Narragansett and Ranger. Vernal had the largest average yields in this test.

On the basis of both tests, Vernal was recommended for all seedings where the stands are to remain for three or more harvest years. NY-A and NY-B (recently named Cayuga) preformed well in all respects and were considered approximately equal to Vernal.

The results of two cutting management experiments were reported. The first was seeded in 1956 and included the Buffalo, DuPuits, and Vernal varieties. They were exposed to five fall cuttings in 1957. The second was seeded in 1958 and included the Buffalo, DuPuits, Rambler, Rhizoma, and Vernal varieties. In 1959, there were cut at the bud and 1/4 bloom stages at the second harvest and each differential cutting was given four different fall managements.

In 1957, a third cutting on either September 16 or 30 caused marked reductions in stands, vigor, and yields of all three varieties in 1958. Buffalo suffered the most from those September harvests. A third harvest on October 14 was much less harmful than the September cuttings and only Buffalo was injured.

Regardless of fall management, the 1959 bud-stage, second cuttings had poorer stands in 1960 than the 1/4-bloom stage ones in 17 of 20 direct comparisons. The average reductions ranged from 30 to 40 percent for the five varieties.

The Buffalo, Rambler, Rhizoma, and Vernal varieties were injured more by a third cutting on September 16 than by October 5 or October 23 harvests. DuPuits suffered least when cut on September 16 but it had a longer growing period than the others after the second cutting.

The average reduction in yield the next season due to the third cuttings was 1,500 pound per acre of dry matter. That amount is 80 percent of the average third cutting yield and 60 percent of the largest fall harvest. When one considers the poorer stands and smaller yields in the next season, and probably for several more years, the advisability of making any third cutting after September 5 was seriously questioned.

U. Conn., Agr. Expt. Sta., Storrs, Conn.

122. Bryant, H. T., and Blaser, R. E. EFFECT OF DEFOLIATION OF FOUR ALFALFAS AND ONE BIRDSFOOT TREFOIL VARIETY ON YIELD OF TOPS AND ROOTS. Va. Agr. Expt. Sta. B. 548, 16 pp. 1963.

Yields and stands of four alfalfa varieties and one birdsfoot trefoil variety grown with orchardgrass were compared under different defoliation intensities. Highest yields were obtained from mixtures cut the least number of times. The lowest yield of forage occurred with the most frequent cutting. The harmful effect of frequent defoliation on forage yield became evident the first year and increased with each succeeding year. Root weights generally decreased as cutting frequency increased.

There was no interaction between varieties and defoliation intensities. Williamsburg alfalfa-orchardgrass was the highest yielding mixture, and Mansfield birdsfoot trefoil-orchardgrass the lowest yielding mixture for the 4 years. Vernal alfalfa-orchardgrass was the highest yielding mixture during the last 2 years. No evidence of bacterial wilt was observed.

Va. Polytech. Inst., Agr. Expt. Sta., Blacksburg, Va.

123. Sprague, M. A., Hoover, M. M., Jr., Wright, M. J., MacDonald, H. A., Brown, B. A., Decker, A. M., Washko, J. B., Sprague, V. G., and Varney, K. E. SEEDLING MANAGEMENT OF GRASS-LEGUME ASSOCIATIONS IN THE NORTHEAST. N.J. Agr. Expt. Sta. B. 804, (Northeast Region P. 42), 74 pp. 1963.

Experiments were conducted in Connecticut, New Jersey, Maryland, Vermont, New York, and Pennsylvania in which nearly identical spring seedlings of three forage mixtures were made in 1954-57. Forage mixtures included alfalfa-bromegrass, ladino clover-orchardgrass, and birdsfoot trefoil-timothy. The seedings were made with and without oats as a companion crop, and four different cutting treatments were applied during the first 3 months of establishment. Data were collected representing: Stand of legumes and grasses about 1, 5, and 12 months after seeding; number of tillers and weights of crowns and roots in the fall following spring seeding; and yield of legumes, grasses, and weeds at the first harvest a year after seeding. In four states during 1957, hand-weeded experiments tested more critically the influence of a companion species.

Forage crops and weeds grew better where oats were not present during the first few months after seeding, and sometimes these differences persisted and were reflected in the production of subsequent years. Forages grew best where neither oats nor weeds were present. Many differences in vigor due to treatment, which were apparent early in seedling development, disappeared during late summer and fall.

A single clipping about the time oats were ripe was most often of greatest benefit to most species. Notable exceptions were ladino clover and birdsfoot trefoil, which were favored by earlier and more frequent clipping. Frequent clipping of alfalfa was detrimental, but no clipping during the establishment year often provided the poorest establishment of any treatment applied. Early clipping of orchardgrass was beneficial and late clipping of bromegrass was helpful.

Poor distribution of rainfall leading to inadequate available soil moisture affected seedling vigor during establishment more consistently than the other variables observed. Periods of moisture stress were accentuated by high temperatures. Soil moisture was depleted more rapidly where oats were seeded, and the more severe clipping treatments reduced the rate of soil moisture depletion measureably.

Decision on the use of a companion crop must be based on a knowledge of local climates and soil moisture characteristics of the particular field. Clipping treatments used on new seedings must be based on the growth of all the species involved as well as the progression of weather elements throughout the establishment period. No single recommendation of seedling management can realistically serve all situations in the northeastern region.

Tables and photographs.

N.J. Agr. Expt. Sta., Rutgers - The State U., New Brunswick, N.J.

124. Hyder, D. N., and Sneva, F. A. STUDIES OF SIX GRASSES SEEDED ON SAGEBRUSH-BUNCHGRASS RANGE: YIELD, PALATABILITY, CARBOHYDRATE ACCUMULATION, AND DEVELOPMENTAL MORPHOLOGY. Oreg. Agr. Expt. Sta. Tech. B. 71, 20 pp. 1963.

Crested, siberian, beardless, pubescent, and tall wheatgrasses and big bluegrass were planted in rows spaced 6, 12, 24, 36, 48, and 60 inches apart on sagebrush-bunchgrass range in April and May 1956. Herbage yields were measured in 1957-61, inclusive, and adjusted to a median precipitation amount to evaluate productivity by age of stands. The preferences exhibited by cattle among plots were observed in July and early August in 1959-61. Seasonal trends in the accumulation of total water-soluble carbohydrates (TWSC) in stem bases were obtained in 1959-60, and crude protein contents in stem bases were sampled in 1960. The developmental morphology of stems was described in 1959-60.

Crested wheatgrass exhibited maximum productivity in the second growing season, a stable productivity in the fifth and sixth seasons, low palatability in July and August, early and fast accumulation of TWSC, and morphological characteristics favorable to spring grazing. Siberian wheatgrass was very similar to crested wheatgrass in the characteristics observed.

Beardless wheatgrass exhibited maximum productivity in the fourth growing season, a stable productivity in the fifth and sixth seasons, moderate palatability in July and August, late and slow accumulation of TWSC, and morphological characteristics favorable to late spring, summer, and fall grazing.

Big bluegrass exhibited maximum productivity in the fourth growing season, a stable productivity in the fifth and sixth seasons, a strong yield decrease with increasing row spacing, high palatability in July and August, intermediately early accumulation of TWSC, weak rooting and susceptibility to pull-up in the first 3 years, and morphological characteristics favorable to early spring and late summer or fall grazing.

Pubsecent and tall wheatgrasses exhibited declining productivities throughout the 6 years, and appeared to be poorly adapted.

Agr. Expt. Sta., Oreg. State U., Corvallis, Oreg.

125. Dudley, D. I., and Holt, E. C. ESTABLISHMENT OF WARM-SEASON GRASSES ON THE GRAND PRAIRIE. Tex. Agr. Expt. Sta. Misc. P. 672, 7 pp. 1963.

Establishment studies involving six perennial warm-season pasture species have been conducted at Substation No. 6, Denton, Tex., since 1953. Planting each of the perennial grasses with oats or wheat as companion crops, generally, was less satisfactory than planting in pure stand on clean prepared seedbeds. Fall planting favored the establishment of both buffalograss and Dallisgrass, while Caucasian bluestem and sideoats grama establishment was improved by planting in early spring. Blue panicgrass and switchgrass performed equally well from either early or late-spring planting.

Rolling the seedbed following planting was important with the later dates of seeding but had no influence on establishment with early seedings. The greatest response to rolling the seedbed occurred when moisture conditions were favorable at planting, since this practice enabled the young seedlings to emerge on existing moisture. When rains occurred soon after planting or when seedings were made in dry soil, the response to rolling was nullified. Preplanting seed treatments such as chilling and soaking in potassium nitrate solution were generally ineffective in improving establishment.

Grass seed decreased in germination percentage in storage. If current germination data are not available, new germination tests should be obtained or seeding rates increased to improve the chances of obtaining a good stand.

Tex. A&M U., Tex. Agr. Expt. Sta., College Station, Tex.

126. Rollins, G. H., Hoveland, C. S., and Autrey, K. M. COASTAL BERMUDA PASTURES COMPARED WITH OTHER FORAGES FOR DAIRY COWS. Ala. Agr. Expt. Sta. B. 347, 27 pp. 1963.

Summer grazing studies were conducted at the Auburn University Agricultural Experiment Station from 1956-61 to compare perennial summer grasses (Coastal Bermuda, Pensacola Bahia, and Dallis), Gahi-1 millet, and alfalfa hay for lactating dairy cows. Annual nitrogen rate was 200 to 250 pounds per acre put on in split applications at intervals of 3 to 6 weeks during the pasture season.

Concentrates were fed at the rate of approximately 1 pound to each 4 pounds of 4 percent fat-corrected milk.

Milk production from continuously grazing Coastal Bermuda, Bahia, and Dallis was unsatisfactory and persistency of lactation was below that normally expected. Irrigation increased the forage yield of Bermuda and Bahia during dry weather, but supplemental water did not improve forage quality or level of milk production.

Rotational grazing of Bermuda and Bahia was of little value in improving forage quality or milk production; however, a combination of intensive management practices--irrigation, clipping surplus forage, applying nitrogen, and rotational grazing at 3-week intervals--resulted in improved milk production by cows on Bermuda.

Gahi-1 millet when intensively managed was consistently the best forage for maintaining lactation at or above the normally expected rate of decline of 6 to 8 percent per month. A combination of intensively managed Bermuda at night and millet during the day, or vice-versa, resulted in lactation performance nearly equal to that on millet alone.

The principle advantages of the intensive managements imposed were: (1) A more uniform, high-quality forage was produced throughout the season; and (2) there was a higher intake of forage by the cows.

No significant changes in bodyweight of the cows occurred during any of these studies.

Agr. Expt. Sta., Auburn U., Auburn, Ala.

127. Jameson, D. A. RESPONSES OF INDIVIDUAL PLANTS TO HARVESTING. Bot. Rev. 29 (4): 532-594. 1963.

In a review of the literature and study of physiological and morphological responses of individual plants to grazing, the author concluded that:

1. Effects of herbage removal by grazing were similar to effects of clipping only when the amount and kind of herbage removed were the same.
2. Removal of a major portion of herbage reduced dry matter yield unless: (1) Clipped plants were present in a mixture and clipping shifted the species composition to a more productive mixture; (2) the site was occupied to a greater than optimum level and clipping reduced occupancy to a more favorable level; (3) the site was not completely occupied and clipping stimulated vegetative reproduction; or (4) plant senescence was prevented by clipping. There may be a temporary increase in dry matter yield for 1 to 3 years followed by a reduction in yield.
3. Legumes appear to be more resistant to cutting treatments than many grasses. Most forbs other than legumes were not resistant to cutting. Shrubs appeared to be resistant to grazing when utilization was expressed in terms of current annual growth.
4. For clipping to stimulate tillering, the growing point or rapidly elongating leaves must be removed. Removal of leaves alone may inhibit sprouting in species that exhibit apical dominance.
5. Plant size and form may be changed under grazing as a result of selection of smaller or more prostrate genotypes within a species.
6. Protein content of forage species declined with maturity, and this decline was lessened or prevented by cutting treatments. With clipping treatments that are not excessive, total protein yield was often greater from clipped plants than from unclipped plants.
7. Seed yield was reduced by clipping and grazing. The processes involved may be: (1) Removal of the floral primordia; (2) removal of the flag leaf, awns or upper leaves, which supply most of the photosynthetic material to the developing seeds; (3) interruption of the photoperiodic stimulus received by leaves; and (4) reduction of plant food reserves. Accumulated carbohydrates contributed only slightly to seed development.
8. Root weights and root growth were generally decreased by clipping. Clipping also reduced the amount of nutrients taken up by roots.

9. In perennial plants, there was a decrease in carbohydrate accumulations with the onset of spring growth. During the rest of the season, carbohydrates of underground parts of plants may increase or decrease. The early spring decline was apparently attributable to utilization of carbohydrates in the production of new leaves. The mid-season decline, when it occurred, was apparently a temperature response or the result of fruit-induced senescence.
10. Severe defoliations resulted in lowered amounts of carbohydrates in the underground portions of herbage plants, and some carbohydrate reserves were needed for production of new leaves after defoliation. Carbohydrates and proteins may be associated with ability of the plant to survive drought, freezing, and other adverse conditions.
11. Although deleterious effects of defoliation on root growth were generally considered to be induced by reduced carbohydrates available to the roots, other substances produced by the leaves and necessary for root growth, such as thiamin and other vitamins, may be involved.
12. Since herbage removal reduces root growth, the smaller root system may in turn give reduced top growth. Effects of roots on tops may include uptake of mineral nutrients and water, and synthesis of chemical substances needed for top growth.
13. Grazing ruminants may supply some vitamins to plants through their saliva.

Rocky Mountain Forest and Range Expt. Sta., FS, USDA, Fort Collins, Colo.

128. Pratt, A. D., and Conrad, H. R. THE EFFECT OF RATIO OF HAY TO SILAGE DRY MATTER ON MILK PRODUCTION. Ohio Agr. Expt. Sta. Res. B. 948, 20 pp. 1963.

Milk production trials were conducted during three winters for 90-day periods to determine the effects of feeding a constant proportion of grain dry matter to forage dry matter and with a varying ratio of silage dry matter to hay dry matter.

In 1954-55, three groups were fed with the following silage: hay dry matter ratios: 100:0, 80:20, and 50:50. In 1955-56, three groups were fed ratios of 50:50, 20:80, and 0:100. During both of these years, silage of about 22 percent dry matter was fed. In 1956-57, silage of 48 percent dry matter content was fed in the ratios of 100:0, 50:50, and 0:100. The silage: hay ratio had no significant effect on milk production.

Cows fed low dry matter silage as their only forage produced more milk per pound of dry matter eaten than cows fed hay as their only forage but at the expense of body weight. During 1956-57 when fed high dry matter silage, they gained body weight but produced less milk.

No well defined trend existed among the other groups.

At least a minimum of hay (perhaps 5 pounds) should be fed to supplement low dry matter silage for cows in high production if they are to maintain their body weights.

Cutting while forage is still immature and ensiling at a favorable dry matter content were important factors in producing silage with high digestible dry matter content. The content of digestible dry matter of silage, the reduction of peak labor loads, the type and amount of storage available, and the machinery requirements for silage or hay making were more important in the considerations than silage: hay ratio in planning the dairy feeding program.

Ohio Agr. Expt. Sta., Wooster, Ohio.

129. Miller, D. D., Skaggs, S. R., and Porter, R. M. ALFALFA SILAGE AS A ROUGHAGE FOR DAIRY COWS. N. Mex. Agr. Expt. Sta. B. 485, 6 pp. 1963.

For 3 years, four groups of lactating dairy cows were fed roughage rations, on the basis of dry matter equivalents, of: (1) All alfalfa hay; (2) 75 percent alfalfa hay and 25 percent alfalfa silage; (3) 50 percent hay and 50 percent silage; and (4) 25 percent hay and 75 percent silage. In addition, these cows received a medium protein concentrate mixture at a uniform rate (about 1:4) based on their milk production.

Response was measured by TDN consumption in excess of their computed maintenance requirements, their production of FCM, and the amount of milk produced per pound of TDN above their maintenance requirements. Body weight changes between groups, chemical components, and coefficients of digestibility of the roughages did not differ appreciably.

In each year, cows fed 25 percent silage and 75 percent hay outproduced the all-hay, or control, group. This difference for the 3 years averaged 10 percent more FCM.

With two exceptions, both in 1960, cows receiving hay-silage combinations consumed less TDN above maintenance requirements than did the control group. Except for these two instances, cows getting both hay and silage consumed progressively less TDN as the percentage of silage in the ration increased.

With the FCM production and the TDN consumption over maintenance requirements of the control group as 100 percent, the other groups compared as follows:

Silage-hay group	FCM Production	TDN Consumption
25-75	110	96
50-50	99	88
75-25	98	71

Alfalfa hay cost $5.75 per ton of dry matter more than the alfalfa silage. Therefore, the results indicate that alfalfa silage, prepared with ground grain as a preservative, can have a profitable place in the dairy feeding program.

Agr. Expt. Sta., N. Mex. State U., University Park, N. Mex.

130. McCaleb, J. E., Hodges, E. M., and Kirk, W. G. SMUTGRASS CONTROL. Fla. Agr. Expt. Sta. C. S-149, 10 pp. 1963.

Smutgrass (Sporobus poiretii Roem. and Schult.) is a serious invader grass in improved pastures on sandy soils of peninsular Florida. This species, a prolific seed producer from May to December in normal years, is unpalatable to beef cattle. Studies at the Range Cattle Station gave the following results.

1. Mowing--cutting vegetation to 3 inches at 1 to 4-week intervals for 13 weeks gave some reduction in plant size when mowed at weekly intervals. Plants recovered to former density.
2. Cultivation--complete renovation with or without winter temporary pastures gave variable and unsatisfactory results, and a follow-up application of herbicides was necessary to eradicate smutgrass. Cultivation in the late spring distributed plants and seeds.

3. Chemical--several herbicides were tested, and dalapon, monuron, and monuron TCA were the most effective. Monuron and monuron TCA were soil sterilants at the rates applied, and their use was limited to spot treatment, usually with excellent results. Dalapon was used either for a spot treatment or overall-spray. One application of 5 pounds active ingredient in 100 gallons water for spot treatment gave kills of 85 percent or better. Continuing retreatment was necessary to kill surviving plants and new bunches starting from seed.

A promising use of dalapon on south Florida pangolagrass pastures was boom-spraying all vegetation in the area to take advantage of the greater susceptability of smutgrass to this chemical.

Do not use treated vegetation for livestock. Most top growth will be killed, and mowing approximately 30 days after application hastened decomposition of sprayed vegetation. (Check label for limitations.)

Smutgrass can best be controlled by prompt action to remove early invaders in improved pastures, followed by constant checking to prevent reinfestation.

Agr. Expt. Sta., U. Fla., Gainesville, Fla.

131. Niemczyk, H. D., and Guyer, G. E. THE DISTRIBUTION, ABUNDANCE AND ECONOMIC IMPORTANCE OF INSECTS AFFECTING RED AND MAMMOTH CLOVER IN MICHIGAN. Mich. Agr. Expt. Sta. Tech. B. 293, 38 pp. 1963.

The distribution, abundance, and economic importance of insects associated with red and mammoth clover in Michigan were determined.

Sixty-seven species of insects, excluding predaceous forms and incidental species, were collected from red and mammoth clover fields during surveys conducted in 1958-59. The 10 most common species in their respective order of abundance were: Philaenus leucophthalmus (L.), Macrosiphum pisi (Harris), Lygus lineolaris (P. de B.), Tychius stephensi Schonh., Therioaphis trifolii (Mon.), Cloanthanus frontalis (Van D.), Aceratagallia sanguinolenta (Prov.), Melaonoplus femurrubrum (De G.), Empoasca fabae (Harris), and Bruchophagus gibbus (Boh.). Five species of thrips were found in second bloom red clover heads during 1960. The two most common species were Frankliniella tritici (Fitch) and Thrips tabaci Lind. The mean number of thrips per head was 9.9.

During 1957 and 1959, studies were made to determine the distribution and magnitude of injury to red and mammoth clover roots by the clover root borer, (Hylastinus obscurus (Marsh.)), and sitonid species, Sitona hispidula (F.), and Sitona flavescens Marsh. Examination of 1730 roots, collected from 173 fields at least in their first crop year, showed, a complete absence of clover root borer injury in the Upper Peninsula, a 6 percent infestation in the upper half of the Lower Peninsula, and a 30 percent infestation in the lower half of the Lower Peninsula. An average of 4.8 borers per infested root was found.

The percentages of the stages found were: larvae, 39 percent; pupae, 21 percent; adults, 40 percent. No injury was found in roots from fields less than 1 year old. Sitonid injury was common over the entire state. Larval feeding scars were noted on 72 percent of the roots examined from fields at least in their first crop year. Of the injured roots, 57 percent were lightly damaged, i.e., 1-5 feeding scars. Twenty-two percent of the roots from eight fields less than 1 year old showed mostly light feeding injury. Notes on the incidence of a mealybug, Pseudococcus sorghiellus Forbes, indicated scattered occurrence over the Lower Peninsula and a single occurrence in the Upper Peninsula.

A study was conducted in the Upper and Lower Peninsulas during 1959 to evaluate damage to red and mammoth clover from seed and head pests and to obtain a measure of the

incidence of fertility among florets available to pollinators. Examination of 500 florets from 100 mature heads collected from each of 50 red clover and 9 mammoth clover fields revealed the following: (1) The weevil Tychius stephensi Schonh., and the clover seed chalcid, (Bruchophagus gibbus (Boh.)), collectively damaged 10 percent of the potentially good seed; (2) the clover seed midge, (Dasyneura leguminicola (Lint.)), rendered 10 percent of the red clover florets unavailable to pollinators; (3) pollinators fertilized 58 percent of the red and mammoth clover florets available to them; and (4) 18 percent of the fertilized florets contained shriveled and malformed ovules.

Mich. State U., Agr. Expt. Sta., East Lansing, Mich.

132. Wysong, J. W. SILAGE COSTS ON NORTHEASTERN DAIRY FARMS. Md. Agr. Expt. Sta. B. A-128 (Region. Tech. B.), 24 pp. 1963.

Silage costs vary widely among dairy farms throughout the Northeast. However, average silage production costs up to harvest showed a considerable degree of uniformity among some of the states. Average total costs per acre for producing corn silage up to harvest were $72 in Delaware, $73 in Maryland, and $77 in New Jersey. Average variable costs per acre were $22, $24, and $25 for Delaware, Maryland, and New Jersey respectively. Similar production-cost data from New Jersey were average total costs per acre of $59 for soybean-sorghum silage and $40 per acre for grass silage.

Average harvest costs for corn silage of $17 and $29 per acre and $1.29 and $2.29 per ton were reported for Delaware and New Jersey, respectively. New Jersey reported average harvest costs of $31 per acre and $3.57 per ton for grass silage and $36 per acre and $2.59 per ton for soybean-sorghum silage.

The most common silage harvest pattern was a three-man crew with three tractors, a forage chopper, and two self-unloading wagons. A silo filler was also required when filling a tower silo. A number of farms had two trucks for hauling silage, instead of two tractors and two wagons.

Total initial costs increased as the storage capacity and size of silo increased for each of the four types of silos considered. However, the average initial investment per ton of rated storage capacity declined at a decreasing rate as the size of the silo increased.

At any given size or capacity of silo, the initial costs were lowest for trench silos with earth floors and earth walls. The bunker silos with concrete floors and wooden walls, the concrete stave tower silos, and the glass-lined steel tower silos had higher initial costs at any given capacity than the unlined trenches. At the 506-ton capacity, the initial costs were $24.30, $14.40, $5.20, and $0.25 per ton, respectively, for glass-lined steel, concrete stave, bunker, and unlined trench silos.

In general, horizontal silos had higher spoilage losses than tower silos.

The unlined trenches provided cheaper storage than the tower silos even when spoilage losses amounted to 10 percent of the total silage stored. The cost per ton of storing silage was lower for bunker silos up to 350 tons of capacity. The concrete stave tower silos became a cheaper means of storage after this quantity.

The larger silos had a definite cost advantage over smaller silos within any type of silo groups considered. Large silos not only had lower initial and annual costs per ton of capacity, but they also had lower labor requirements per ton of silage.

U. Md., Agr. Expt. Sta., College Park, Md.

SEE ALSO 57, 139, 274.

133. Extension Service. COLORADO RANGE MANAGEMENT HANDBOOK. Colo. State U. Ext. Serv. B. 457A, 63 pp. 1963.

This handbook was designed and arranged to present range management information in a logical step-by-step manner--a manner that progresses from single range principles to suggestions for actual range management enterprises.

A major portion of the material contained in this handbook was taken from "Range, Its Nature and Use," a manual for youth groups developed by the Committee for Cooperation with Youth, American Society of Range Management.

Colo. State U., Ext. Serv. Fort Collins, Colo.

134. Campbell, R. S., Halls, L. K., and Morgan, H. P. SELECTED BIBLIOGRAPHY ON SOUTHERN RANGE MANAGEMENT. U.S. Forest Serv. Res. Paper SO-2, 62 pp. 1963.

Important publications were listed that relate directly to southern ranges, the domestic livestock and wildlife produced thereon, and the management of these lands, livestock, and wildlife. Range was defined as natural grassland, savannah, or forest that supports native grasses, forbs, or shrubs suitable as forage for livestock and game. Land under cultivation or in improved pasture was excluded.

The southern region included all of the States from Virginia to Arkansas and Louisiana, the southern portions of Kentucky and Missouri, and the eastern portions of Texas and Oklahoma.

Southern Forest Expt. Sta., FS, USDA, New Orleans, La.

135. Johnston, M. C. PAST AND PRESENT GRASSLANDS OF SOUTHERN TEXAS AND NORTHEASTERN MEXICO. Ecology 44: 456-466. 1963.

Accounts of the middle of the last century show the prevalence of low, woody vegetation in southern Texas and northeastern Mexico. Relatively limited areas near the coast were grasslands, including the coastal prairies and large parts of the Wild Horse Desert or Eolian Plain. The small Loreto caliche-sand plain of coastal Tamaulipas, judging by present vegetation, was also largely grassland.

The present vegetation of the Kleberg clay prairies near the coast in southern Texas includes low grasses of the genera Buchloë, Chloris, and Hilaria. In prairies on sandy soil in southern Texas, Andropegon scoparius var. littoralis is abundant or dominant where not removed by grazing. The Loreto grasslands are unique in that Bouteloua radicosa is abundant in them.

A relatively limited proportion of the areas which were grassland about 100 years ago are now occupied by low woody vegetation, including the southern part of the coastal prairie in Texas, of which the Kleberg clay prairies are remnants. The grasslands of sandy soils have apparently diminished in area both by peripheral shrinkage and expansion of internal mottes. In many areas, the woody vegetation is now thicker and more nearly exclusive of

grasses and forbs. Many "grasslands" were infested with the ubiquitous mesquite (Prosopis glandulosa) in a stunted growth form long ago, and the rapid takeover of the mesquite brush involved increase in stature of the aerial parts of the plant and in density of stand, rather than invasion of previously brush-less areas. Most authors feel the control of fires explains the shrinkage of grassland. Nothing in this study contradicts such an explanation.

Plant Res. Inst., U. Tex., Austin, Tex.

136. Dwyer, D. D., Elder, W. C., and Singh, G. EFFECTS OF HEIGHT AND FREQUENCY OF CLIPPING ON PURE STANDS OF RANGE GRASSES IN NORTH CENTRAL OKLAHOMA. Okla. State U. Expt. Sta. B. B-614, 10 pp. 1963.

The response of little and big bluestems, indiangrass, switchgrass, Tucson and El Reno sideoats grama, and King Ranch bluestem to various clipping regimes was studied in north central Oklahoma from 1955-60.

Six years of clipping data revealed the following information:

1. The greatest yield for all species occurred at the annual July clipping at the 2-inch level.
2. Indiangrass and big bluestem were similar in response, with indiangrass having some advantage. These two species showed the greatest potential of the species studied for production in pure stands. Switchgrass and Tucson sideoats showed the least potential. Switchgrass did not appear to be adapted to regular mowing or clipping.
3. Forage yield was over 25 percent greater for all species at the 2-inch clipping level over the 4-inch level. Root production in the upper 4 inches of soil was reduced under the 2-inch clipping level.
4. Stand density and plant vigor decreased, and broadleaved weeds and annual bromes increased under increased frequency of clipping.

Okla. State U. Expt. Sta., Stillwater, Okla.

137. Rauzi, F., Lang, R. L., and Becker, C. F. INTERSEEDING RUSSIAN WILDRYE INTO NATIVE SHORTGRASS RANGELAND. Wyo. Agr. Expt. Sta. B. 406, 8 pp. 1963.

A study to determine the feasibility of using the Wyoming range seeder to introduce Russian wildrye into native shortgrass rangeland was begun in the spring of 1960.

A set of four tillage treatments (6-, 12-, 18-, and 24-in. widths) was applied each year for 3 years. Each tillage treatment consisted of four rows 50 ft. long. Of the four rows, an inner and an outer row received treble superphosphate at a rate equivalent to 60 lbs. per acre. All rows received Russian wildrye at the rate of 8 lbs. per acre except for 1960. The significant results obtained were:

1. There were significantly more seedlings of Russian wildrye established in the 18- and 24-in. tillage widths than either the 6- or 12-in. tillage width.
2. The effect of phosphate alone was significant only in 1961, which was a wet year.
3. The draft requirements for establishing the various tillage widths used were not significantly different.

U. Wyo., Agr. Expt. Sta., Laramie, Wyo.

771-426 O-65—6

138. Norris, J. J., Valentine, K. A., and Gerard, J. B. MESQUITE CONTROL WITH MONURON, FENURON, DIURON. N. Mex. Agr. Expt. Sta. B. 484, 14 pp. 1963.

Effectiveness of the three herbicides in killing mesquite was compared and information was collected on dosage required to kill plants; methods of application; carrier for the chemical; and season of greatest effectiveness. Data were also collected on per acre costs and plant kills using monuron treatments on individual plants on a field basis.

Monuron was significantly more effective in killing mesquite than fenuron or diuron when applications consisted of 2 grams of the 100 percent powder suspended in a quart of water poured at the base at the plant. At 1962 prices, cost of material per plant killed was 5.2 cents with monuron and 12.6 cents with fenuron.

Applying the monuron powder in water killed a larger percentage of the mesquite plants than applying the dry powder. However, the increased kills probably did not justify additional costs involved in use of the water.

Pouring the suspension on the soil surface around the base of the plant was significantly more effective than foliage spray, pouring into a small hole near the tap root, or pouring into shallow trenches 3 feet long and 5 or 10 feet from the plants.

About 1 gram of the active ingredient in monuron per foot of plant crown diameter resulted in kills of 80 percent or more of the treated plants in the 2 to 8 feet diameter classes. Plants larger than 8 feet in diameter required more of the chemical and the dose was increased by about one-third.

Analysis of mesquite kill data showed significant to highly significant differences between years of treatment. Slightly greater kills resulted when monuron was applied during the early and middle parts of the growing season of mesquite (May 15-August 1) than from treatments earlier or later.

Cost of treating mesquite with monuron on a field basis depended upon the number of plants per acre and varied from 27 cents for 2 plants up to $2.00 for 78 plants. All of the areas treated on a field basis averaged 21 plants per acre and were treated at an average cost of 87 cents per acre. Comparison of results from monuron and 2,4,5-T ground spray applications showed that on mesquite stands of 8 to 15 plants per acre monuron treatment was cheaper. Ground spray with 2,4,5-T was cheaper where plants exceeded 15 per acre.

Systematic working back and forth across the range in belts was necessary to find and treat all plants without undue overlapping. Dosage per plant was best measured in the field by teaspoons. For 80 percent monuron powder, the dose was approximately $\frac{1}{2}$ teaspoon for plants with 1 foot crown diameter and increased by $\frac{1}{2}$ teaspoonful with each additional 1 foot increase in diameter. Where monuron in powder form is used, it should be placed near the base of the plant and covered with soil to reduce loss through wind erosion.

Agr. Expt. Sta., N. Mex. State U., University Park, N. Mex.

Plant Materials

SEE ALSO 73, 75, 76, 107, 108, 119, 121, 122, 126, 127, 154, 156, 170, 183, 186, 187, 188, 189, 199, 200, 222.

139. Wilbur, R. L. THE LEGUMINOUS PLANTS OF NORTH CAROLINA. N.C. Agr. Expt. Sta. Tech. B. 151, 294 pp. 1963.

The leguminous plants of North Carolina were described and illustrated.

Of the 500 or more genera and 12,000-15,000 species comprising the Leguminosae, North Carolina's representation consists of about 172 species belonging to 49 genera.

Key, maps, and drawings.

N.C. Agr. Expt. Sta., N.C. State Col., Raleigh, N.C.

140. Beaty, E. R., and Powell, J. D. AMCLO: A NEW CLOVER TO RIVAL CRIMSON. Ga. Agr. Res. 5(1): 3,6. 1963.

A new clover introduction from Italy, PI 234310, Trifolium vesiculosum (Savi), tested at the Americus Plant Material Center and released under the name of Amclo, shows promise of being superior to Crimson clover as a forage in Georgia.

Amclo is a winter annual that germinates in the fall and grows very little during fall and early winter. Starting in March it makes extremely rapid growth until full bloom. It starts blooming in early May, reaches full bloom in mid May, and is ready to combine for seed in early to mid June. Crimson clover (T. incarnatum L.), by comparison, is approximately 20 to 30 days earlier in floral development than Amclo.

Data in Table show that Amclo has consistently outyielded Crimson. Most of the extra growth of Amclo was probably due to the longer growing season.

Table. Production of Amclo and Crimson Clovers, 1959-1961.

Crop	Year			
	1959	1960	1961	Average
	pounds dry forage per acre			
Amclo**	4,465	10,868	7,787	7,713
Crimson	1,213	1,866	3,658	2,246

**Difference between clovers highly significant for each year.

Seeding rates were 4 pounds per acre in 36-inch rows and 10 pounds per acre broadcast. Both of these seeding rates have produced complete cover of the area. Row seeding may be best for seed production.

In Georgia, for either seed or forage, a seeding date of between October 15 and November 20 was satisfactory.

Amclo has reseeded well on cultivated areas but has not been tested on Bermudagrass or Bahiagrass sod.

Ga. Agr. Expt. Sta., U. Ga. Col. Agr., Athens, Ga.

141. Rom, R. C., and Arrington, E. H. PEACH VARIETY EVALUATION. Ark. Agr. Expt. Sta. Rpt. Ser. 122, 22 pp. 1963.

The data recommendations given were based primarily on the performance of peach varieties grown at the Peach Substation, Nashville, Ark., from 1958-61, and evaluations for processing were based on varieties grown at the main Station at Fayetteville.

Area adaptability of a variety in no way assures excellent and continued production. To a large measure, the ultimate expression of variety performance is the responsibility of the individual grower, who, through careful and select cultural practices, brings the variety to its highest production and quality attainment.

Variety selection is indirectly controlled by the market. Trends indicate that buyers are demanding a reduction in the number of varieties in the trade. Consumers are buying fruit primarily for immediate consumption; home processing of peaches is declining. Thus, eye appeal and fresh market quality have become dominant factors. The market and consumer have shown a willingness to purchase fruit in special packs at a premium price. The grower should thoroughly consider these trends in selecting varieties to plant.

SUMMARY OF CURRENT RECOMMENDATIONS

Recommended for Commercial Acreage

Dixired
Redcap
Dixiegem
Redhaven
Ranger
Redelberta (with reservations)
Loring
Elberta
Redskin

Recommended for Trial Plantings, Moderate Acreage

Earlired
Cardinal
Sunrise
Keystone
Newday
Redglobe
Redgold
Sunhigh
Blake

Recommended for Local Fresh Market Sale Only

Geheb (white)
Nectar (white)

Agr. Expt. Sta., U. Ark., Fayetteville, Ark.

142. Johnston, T. H., Adair, C. R., Templeton, G. E., Sims, J. L., and Henry, S. E. NOVA AND VEGOLD--NEW RICE VARIETIES. Ark. Agr. Expt. Sta. B. 675, 22 pp. 1963.

Nova, a medium-grain variety, and Vegold, a long-grain variety, were developed in the rice improvement program conducted cooperatively at the Rice Branch Experiment Station at Stuttgart, Ark. Foundation seed of both varieties were released to qualified seed growers in 1963.

Nova, an early maturing (short-season), smooth-hulled, medium-grain variety, was tested extensively at several locations in Arkansas from 1958-62. It is similar to Nato, the predominant medium-grain variety, but matures about 4 days earlier, has somewhat greater lodging resistance, produces slightly higher rough rice yields, and produces slightly larger and less chalky kernels. Limited observations indicate that Nova is well adapted to combine harvesting since it threshes easily but does not appear to shatter. The per-acre head rice yields of Nova and Nato were about equal. Cooking and processing characteristics of the two varieties were very similar.

Nova has exhibited a much greater degree of resistance to rotten-neck blast under field conditions in Arkansas than has Nato. Nova is resistant to hoja blanca, whereas Nato is susceptible.

Vegold is a very-short-season, long-grain variety derived from a multiple hybrid. Vegold matures about 4 days later than Belle Patna, is more resistant to lodging, and produces higher head rice yields. Vegold and Belle Patna produce about equal yields of grain, on the average. Vegold is similar in cooking characteristics to Bluebonnet 50. Vegold is

regarded as a special-purpose variety because it is well suited for early June seeding in northern Arkansas and for mid-June and late June seeding in central and southern Arkansas, respectively.

Vegold, like Belle Patna, requires adequate weed control, careful management of irrigation water, and timely application of nitrogen fertilizer for good yields.

Agr. Expt. Sta., U. Ark., Fayetteville, Ark.

143. Caldwell, R. M., Compton, L. E., Patterson, F. L., and Schafer, J. F. DECATUR WINTER BARLEY. Ind. Agr. Expt. Sta. Res. B. 768, 8 pp. 1963.

Decatur winter barley, distributed in the fall of 1960, makes available for Indiana, a very stiff-strawed variety which will stand well for combine-harvesting. Its yielding capacity is in the range of other recently grown varieties, and it particularly competes in yield in southern Indiana, the primary area of Indiana barley production. Decatur is satisfactory in winter hardiness and test weight. It is resistant to scald and moderately resistant to leaf rust and net blotch. The major problem is susceptibility to the powdery mildew disease.

Decatur is recommended for production in the southern half of the State and is considered acceptable elsewhere. The availability of this superior-standing variety makes winter barley a more desirable and competitive crop for southern Indiana.

Purdue U., Agr. Expt. Sta., Lafayette, Ind.

144. Canode, C. L., and Van Keuren, R. W. SEED PRODUCTION CHARACTERISTICS OF SELECTED GRASS SPECIES AND VARIETIES. Wash. Agr. Expt. Sta. B. 647, 15 pp. 1963.

The seed production characteristics of selected varieties and species of cool-season grasses were evaluated at Pullman, without irrigation, and at Prosser with irrigation.

Tall fescue was the high producing species at Pullman, with a 3-year average seed yield of 916 lbs. per acre. Red fescue, smooth brome, and crested wheatgrass followed tall fescue in seed yield in the order listed. Timothy was a low producing species at Pullman; Drummond made 185 and Climax 283 lbs. of seed per acre for the 3-year average. Astoria bentgrass averaged 195 lbs. of seed per acre for the 3-years.

Timothy was the high seed producing species at Prosser (1087 lbs. per acre), followed by smooth brome, tall fescue, Siberian wheatgrass, and one variety of orchardgrass. Bentgrass was the low producing species with 3-year average seed yields of 365 lbs. per acre for Penncross and 411 for Astoria.

Varieties of the same species differed significantly in seed production in most comparisons at both locations. The seed yields of varieties of a given species were in essentially the same rank at both locations, except for bluegrass. Merion Kentucky bluegrass yielded more seed than the Pacific Northwest selection at Pullman; the reverse was true at Prosser.

Varieties of a given species had essentially the same rank at both locations and retained the same position throughout the trials. The seed weights were influenced by age of stand; this result may have reflected the high correlation with seed yields. Seed weights and seed yields were generally higher in the first or second harvest year and declined in the second or third harvest year.

Test weights per bushel were not strongly correlated with seed yields but the weight of 100 seed was. At Pullman, the test weights tended to decrease with age of stand for the first

3 years of production for all varieties, except bluegrasses. No substantial changes in bushel weights occurred for most of the grasses as the stand aged when the varieties were grown under irrigation at Prosser.

The high correlation of the seed yields of the first production year with subsequent years and with the long-time average at both locations indicates the reliability of predicting seed yield potential of new varieties from limited data. The low correlation of seed yields of varieties grown in decidedly different environments appeared to be due primarily to species adaptation.

Wash. Agr. Expt. Sta., Inst. Agr. Sci., Wash. State U., Pullman, Wash.

Woodlands

SEE ALSO 1, 2, 3, 4, 47, 55, 59, 72, 73, 253, 265, 274.

145. Johnson, F. A., and Worthington, N. P. PROCEDURE FOR DEVELOPING A SITE INDEX ESTIMATING SYSTEM FROM STEM ANALYSIS DATA. U.S. Forest Serv. Res. Paper PNW-7, 10 pp. 1963.

Site index curves for red alder were developed from stem analysis data by a procedure which has since been adopted for lodgepole pine in eastern Oregon and for aspen in Alaska. In these three cases, the results have been so encouraging that a detailed description of the procedure seems justified. The red alder data was used to illustrate the procedure.

Pacific Northwest Forest and Range Expt. Sta., FS, USDA, Portland, Oreg.

146. Sternitzke, H. S. ALABAMA FORESTS. U.S. Forest Serv. Res. B. SO-3, 32 pp. 1963.

Between the 1953 and 1963 Alabama forest surveys there was a period of many changes. Shifts in land use and changes in product demand, timber growth, cutting, management, and many other factors importantly affected the State's forest resources.

The pulp and paper industry greatly enlarged its capabilities. The volume of pulpwood bolts harvested in 1962 topped that of saw logs by nearly 25 percent.

The lumber industry developed a new and profitable market for plant residues that were formerly regarded as unavoidable waste. At least 120 Alabama sawmills convert slabs and edgings, chiefly pine, into high-quality chips for sale to pulpmills. The equivalent of one in every six cords of pine pulpwood produced in Alabama is currently derived from chips. Use of hardwood residues is also gaining, although handicapped by the need to separate species for most pulping processes.

Alabama's veneer industry, which consumes mainly soft-textured hardwoods such as sweetgum, shrank from 42 to 34 plants during the past decade.

In response to demand for treated wood, 17 new wood-preserving plants have been constructed since 1951. Of the 25 establishments now operating, 21 are pressure-type.

Both public agencies and forest industries are sponsoring programs of technical assistance to stimulate good practices on small woodlands. Management of hardwoods, however, has progressed much less than pine.

In area, the forests are 5 percent or one million acres greater than in 1953 and occupy 67 percent of Alabama's total land area. In volume, softwood growing stock (virtually all pine) has risen 28 percent, and softwood sawtimber has gained 30 percent.

Several million acres that are capable of growing pine are dominated by other species. Volume in high-quality hardwoods--that is, those most suitable for factory lumber and veneer--has declined precipitously. One in every four hardwoods is a cull. The current growth of timber is less than half of the potential.

Almost 15 of Alabama's nearly 22 million forest acres are in ownerships of less than 5,000 acres. On these holdings especially, there are numerous opportunities for increasing future supplies of timber that can support new industries. The greatest possibilities for enhancing forest productivity are in raising the level of pine stocking and in applying stand improvement practices on all sites capable of growing high-quality hardwoods rapidly. The most promising remedial measures are to remove culls and other low-value trees that are interfering with the growth or establishment of desirable ones; to plant pine sites on which adequate natural regeneration is not likely; and on hardwood lands especially, to plan timber harvests in a way that will insure a buildup in trees of the quality, sizes, and utility normally demanded for industrial purposes.

Southern Forest Expt. Sta., FS, USDA, New Orleans, La.

147. Worthington, N. P. THIRTEEN YEARS OF THINNING IN A DOUGLAS-FIR WOODLAND. U.S. Forest Serv. Res. Note PNW-8, 4 pp. 1963.

A 40-acre tract on the McCleary Experimental Forest in Grays Harbor County, Wash., was managed for 13 years to demonstrate that an annual income can be produced from thinning, while, the potential growth of the land is increasing.

This 57-year-old stand, which became established after repeated burns of the area, is about two-thirds Douglas-fir, interspersed with western redcedar, western hemlock, and red alder. The soil, derived from a basalt cap, is Olympic 1.

In 13 years, the average diameter of trees over 10 inches has increased from 14.0 inches d.b.h. to 16.2 inches. Volume removed in a single thinning averaged 4,446 board feet per acre for the first few years and 2,989 board feet per acre for the 13-year period.

Coniferous timber, comprising 85 percent of the total cut, was made into saw logs and veneer logs. Alder was utilized as saw logs and pulpwood. Total stumpage sales for the 13 year period brought $3,383.54, or $6.51 per acre annually. Stumpage averaged $11.13 per M board feet for Douglas-fir, and $5.43 for alder. Fixed private ownership expenses were $320.88. Direct management expenses such as yield taxes, roads, marking, and sale administration were $1,494.10. All costs averaged $3.48 per acre annually. Net annual cash return from operation of the tract was $3.03 per acre. Added to this amount should be the increase in growing stock, worth at present prices ($15.00 per M board feet) $4,027.80, or $7.20 per acre per year, so that total net return was $10.23 annually. A compound interest rate of 5.7 percent annually has been realized on the 1948 value of the growing-stock volume.

Value of salvaged mortality has averaged 46 percent of road depreciation and maintenance costs for the 13-year period. Mortality salvaged in stands over 40 years old can in many cases finance the total cost of road construction and maintenance.

Pacific Northwest Forest and Range Expt. Sta., FS, USDA, Portland, Oreg.

148. Barrett, J. W. DOMINANT PONDEROSA PINES DO RESPOND TO THINNING. U.S. Forest Serv. Res. Note PNW-9, 8 pp. 1963.

In 1953, a study was established in a pole-sized stand of ponderosa pine (Pinus ponderosa) to determine the growth response of dominants released from all lower crown class tree competition.

During the first 6 years after thinning, dominant tree response to release was in diameter increment with no clear-cut stimulus to height growth. Response to release based on width of growth rings was about the same for all size classes from 4 to 12 inches d.b.h. Cubic volume accumulated at a greater rate on released trees.

Lower crown on released trees remained live longer than on dominant trees in the natural, unthinned stands. Without pruning, this trend could lead to significant lumber grade differences between thinned and unthinned stands.

Release of dominant trees to wide spacing may help to maintain or stimulate the flow of wood to market by accelerating attainment of tree size classes which might be lacking in the existing stand structure.

Pacific Northwest Forest and Range Expt. Sta., FS, USDA, Portland, Oreg.

149. Boyer, W. D. DEVELOPMENT OF LONGLEAF PINE SEEDLINGS UNDER PARENT TREES. U.S. Forest Serv. Res. Paper SO-4, 5 pp. 1963.

In the absence of fire, overstory density had no effect on seedling survival. Seedlings survived and remained healthy under overstories ranging up to 90 square feet of basal area per acre, under which survival of 7-year-old seedlings averaged 80 percent.

Fire mortality was related to parent-tree competition. Differential suppression by seed trees and forest walls resulted in seedlings varying in size. Prescribed fires then caught many seedlings either too small or too large to be resistant. Most fire losses occurred directly under parent trees, where maximum suppression was combined with maximum accumulation of needle fuel.

Though the retarding effect diminishes rapidly with distance, even light overstories suppressed growth severely. A relatively light overstory of 30 square feet of basal area per acre accounted for more than 70 percent of the size difference between opengrown seedlings and those beneath an overstory of 90 square feet.

Brown-spot infection of longleaf seedlings was high in open areas and low within forest stands. The presence of an overstory appeared to inhibit the development of the disease.

Seedlings established in one of the occasional good longleaf seed years can be stored under a full and productive pine overstory until scheduled harvest cuts take place. Overstory removal can then be based on the needs of management rather than a silvicultural requirement for prompt seedling release.

Southern Forest Expt. Sta., FS, USDA, New Orleans, La.

150. Baron, F. J., and Schubert, G. H. SEEDBED DENSITY AND PINE SEEDLING GRADES IN CALIFORNIA NURSERIES. U.S. Forest Serv. Res. Note PSW-31, 14 pp. 1963.

The increased use of seedlings (1-0 and 2-0) instead of transplants in reforestation programs in California has reduced unit costs and speeded production. Density of sowing is of great importance where seedling stock is grown. In transplant beds, the trees finish their nursery growth at uniform spacing. But in seedling beds, seeding method largely regulates density. Studies on relating seedbed density to seedling quality at the Mt. Shasta and Placerville nurseries of the U.S. Forest Service were reported.

Lower seedbed densities for pine planting stock in California produced larger, more vigorous seedlings. Both 1-0 stock from a Placerville nursery and 2-0 stock from a Mt. Shasta nursery increased in average stem diameter and fresh weight as the numbers of plants per square foot of seedbed were reduced from 60 to 10. Two seasons after hand

planting, field survival of Mt. Shasta stock grown at 50 per square foot was 62 percent; that of stock grown at 10 per square foot was 83 percent. After machine planting with comparable stock, survival was 79 and 92 percent.

Pacific Southwest Forest and Range Expt. Sta., FS, USDA, Berkeley, Calif.

151. Williamson, R. L. GROWTH AND YIELD RECORDS FROM WELL-STOCKED STANDS OF DOUGLAS-FIR. U.S. Forest Serv. Res. Paper PNW-4, 28 pp. 1963.

In 1910, establishment of a series of permanent sample plots was started in young-growth stands of Douglas-fir in western Oregon and eastern Washington. Thirty-one of these plots were measured periodically to determine growth, mortality, and yield.

A summary of the data and analyses resulting from these plots were given.

Stands sampled were even aged and well stocked, with an age span of 38 to 119 years and a range in site quality from I through IV.

Tables.

Pacific Northwest Forest and Range Expt. Sta., FS, USDA, Portland, Oreg.

152. Brown, J. H., and Gould, W. P. DIRECT SEEDING OF CONIFERS IN RHODE ISLAND. Tree Planters' Notes 61: 1-4. Oct. 1963.

A mixture of white pine, pitch pine, and hemlock seed treated with Arasan 75 and endrin was sown in the fall and spring at the rate of 6 pounds of white pine, 2 pounds of pitch pine, and 2 pounds of hemlock per acre on a bulldozed site in western Rhode Island.

At the end of two growing seasons, the fall-sown area contained a stand of 14,140 seedlings, including 3,284 white pine, 9,428 pitch pine, and 1,428 hemlock seedlings. The spring-sown area contained a stand of 8,800 seedlings per acre, with 2,600 white pine, 6,000 pitch pine, and 200 hemlock seedlings.

U. R.I., Kingston, R.I.

153. Derr, H. J. BETTER REPELLENT FOR DIRECT SEEDING. Tree Planters' Notes 61: 26-30. Oct. 1963.

A new, improved bird repellent without most of the defects of previous formulations used in direct seeding was developed by researchers at Alexandria, La. Arasan 42-S, a liquid suspension of thiram (tetramethyl-thiuramdisulfide), is easy to apply and forms a durable coating that is free of noxious dust. It can be blended with Endrin 50W for protection from rodents and other seed-eating mammals, and is as effective as the two chemicals previously recommended for field or nursery sowing, sublimed synthetic anthraquinone and Arasan 75.

The new repellent contains the same active ingredient--thiram--as Arasan 75, but it is formulated as a finely ground water suspension instead of a wettable powder. It contains 4 pounds of active material per gallon, and apparently the suspension can be stored indefinitely if it is not allowed to freeze. There is no dust during seed treating, and when it is properly applied the repellent mixture forms a relatively hard seedcoating that releases a

minimum of dust after drying. It resists weathering better than coatings of the other two repellent materials, and it does not affect field germination of longleaf, slash, or loblolly pine seeds.

Methods of application were given.

Southern Forest Expt. Sta., FS, USDA, Alexandria, La.

154. Johnson, R. L., and Krinard, R. M. PLANTED YELLOW-POPLAR OUTPERFORMS SIX OTHER SPECIES ON LOESS SITES. Tree Planters' Notes 61: 11-12. Oct. 1963.

After 2 years in an experimental plantation on the brown loam bluffs near Vicksburg, Miss., yellow-poplar trees averaged two to six times taller than southern red oak, cherrybark oak, water oak, swamp chestnut oak, Shumard oak, and sweetgum.

The study began in the fall of 1960, when overstory trees, predominantly American beech, were cut (when merchantable) or deadened on four separate blocks in a mixed stand of bluff hardwoods. In January 1961, 20 locally grown 1-0 seedlings of each of the seven species were planted on each of three sites within each block. The sites were bottoms (0-5 percent slope), medium slopes (15-22 percent slope), and steep slopes (29-35 percent slope). Soils were Vicksburg, Memphis, Wakeland, Falaya, and Collins sil. All can produce good hardwoods.

After two growing seasons, the average height of yellow-poplars was 8.5 feet. Sweetgum, swamp chestnut oak, and Shumard oak heights were slightly less than 5 feet, and the heights of water oak, cherrybark oak, and southern red oak were 3.4, 2.9, and 1.4 feet, respectively. The differences between yellow-poplar and the other species were statistically significant at the 0.01 level.

For all species combined, there were no significant differences in growth or survival among the three sites. Survival percentages were 89 or higher for all species except southern red oak, which averaged 69 percent.

Southern Forest Expt. Sta., FS, USDA, Stoneville, Miss.

155. Russell, T. E. PLANTED SHORTLEAF RESPONDS TO PROMPT RELEASE. Tree Planters' Notes 61: 13-16. Oct. 1963.

Controlling competing hardwoods on the Cumberland Plateau increased the growth of planted shortleaf pine. Immediate release by girdling and cutting plus applying silvicide gave best growth of shortleaf pine planted under low-grade hardwoods near Sewanee, Tenn. Delaying the release for 1 and 2 years after planting did not significantly affect survival or growth after release, although development before release was retarded by competition with hardwoods. Release without silvicide resulted in poorer growth for the 5-year period.

Five years after they were planted, pines that had been released immediately with silvicide averaged 6.2 feet in height. Where release with silvicide was deferred for 1 or 2 years, they averaged 4.9 and 3.7 feet, respectively. Immediate release without 2,4,5-T yielded saplings that averaged only 4.7 feet tall and they grew less than 1 foot during their 5th year. Fifth-year growth was more than 1.5 feet where girdling and cutting had been supplemented with silvicide, regardless of year of release. Unreleased pines averaged only 1.5 feet in height after 5 years in the field.

After 3 to 5 years, depending on year of release, hardwood brush again covered 28 to 35 percent of the plots where silvicide had been used, but enough pines were free to grow to make satisfactory stands.

Southern Forest Expt. Sta., FS, USDA, Sewanee, Tenn.

156. Garin, G. I. CHRISTMAS TREE PRODUCTION IN EASTERN REDCEDAR AND ARIZONA CYPRESS PLANTATIONS. Ark. Agr. Expt. Sta. C. 145, 13 pp. 1963.

Eastern redcedar (Juniperus virginiana L.) and Arizona cypress (Cuprussus arizonica Greene) were grown for Christmas trees on light sandy soil in central Alabama. The trees were planted at a 4 X 4-foot spacing. Open spots where trees died or were cut were not replanted. Trees were pruned and sheared to develop the desirable taper of high quality Christmas trees. They were harvested when they reached marketable size and sold locally. Customers' reactions to the two species of trees were noted. The author concluded that:

1. Survival of trees reaching harvestable size was 79 percent for eastern redcedar and 65 percent for Arizona cypress.
2. Both species required some pruning and considerable shearing to develop desirable taper. Developing well proportioned trees was the most serious problem encountered in producing high quality Christmas trees. A number of Arizona cypress trees would never have become marketable without this practice.
3. Stump culture apparently can be used to increase the Christmas tree yields of both species. Arizona cypress shows a greater promise of increased production than eastern redcedar.
4. First trees were harvested from Arizona cypress at 4 years of age from eastern redcedar at 8 years of age.
5. Arizona cypress reached peak of production at age 11 when over 75 percent of the trees were harvested. Eastern redcedar reached best production rate at from age 11 to 16 with 75 percent of trees harvested at 15 years of age.
6. Customers preferred Arizona cypress over eastern redcedar because of its more attractive color and dull scales which were not irritating to hands in handling.

Agr. Expt. Sta., Auburn U., Auburn, Ala.

157. Box, B. H. LOUISIANA-GROWN CHRISTMAS TREES. La. Agr. 7(2): 4-5. 1963.

The School of Forestry and Wildlife Management has been testing Arizona cypress to determine whether this species can be commercially grown in Louisiana. A plantation was established on a well-drained, old-field site at the Lee Memorial Forest, near Bogalusa, in March 1961. The trees were planted on a 6 X 6-foot spacing on an area of 1.6 acres that had been double-disced. After it had been planted, the area was divided into 36 blocks of equal size. This allowed five replicated fertilizer treatments and a check.

On August 23, 1963, the plantation averaged 78 percent survival and 5.2 feet in height. The fertilized plots had the same height as the unfertilized plots. A tally of the 1,385 surviving trees showed that 221 (16 percent) were suitable in size and form for Christmas trees in 1963, and that most of the remaining trees would be large enough for Christmas trees in 1964.

Arizona cypress was tentatively recommended for planting throughout Louisiana on well-drained, old-field sites. This species grew poorly on heavy soils that tended to remain wet over long periods of time.

TABLE 1.--Estimated Costs and Returns for an Acre of Arizona Cypress Christmas Trees on a Four-Year Rotation

Item	Amount	Cost or income per unit	Cost or income per acre
Site preparation cost	One acre	$20/acre	$ 20.00
Seedling cost	1,210 seedlings	$15/1,000	18.15
Planting cost	One acre	$10/acre	10.00
Pruning cost	16 hours	$1.25/hour	20.00
Cultivation cost	4 annual cultivations	$9/cultivation	36.00
Harvest cost	847 trees	$.25/tree	211.75
Freight and handling cost	847 trees	$.25/tree	211.75
		Total Costs	$527.65
Gross returns (wholesale)	847 trees	$1.00/tree	$847.00
Net returns (gross returns minus total costs)			$319.35

Good results can be achieved if the following procedure is carried out:

1. Prepare the planting site well. Disc and section-harrow the area at least 1 month prior to establishing the seedlings.
2. If the soil is deficient in nutrients, use a balanced fertilizer suitable for the area. Distribute the fertilizer equally over the planting area.
3. Plant on a 6 X 6-foot spacing so that cultivation may be done by conventional tractors using regular equipment.
4. Proper care and handling of the seedlings is important. Do not let the seedlings dry out before or during planting.
5. Use a planting dibble or machine. Plant the seedlings at least 2 inches lower in the ground than they grew in the nursery.
6. Do not plant the seedlings while the planting site is in a saturated condition.
7. Control weed competition by mowing; discing or section-harrowing may disturb the root system.
8. Pruning or shaping of the trees should be done on malformed or forked trees early in the second growing season (May or June).
9. Arizona cypress has few known insect enemies, but it is attacked by cedar blight (Phomopsis blight). Should it occur, the infected seedlings should be sprayed with "Special Semesan" using 1 pound per 100 gallons of water or Fermate using 3 pounds per 100 gallons of water. Seedlings which die from the blight should be removed from the plantation.

La. Agr. Expt. Sta., La. State U. and Agr. and Mech. Col., Baton Rouge, La.

158. Rudolph, V. J., and Lemmien, W. A. SHEARING SCOTCH AND RED PINE CHRISTMAS TREES FOR CONTROL OF THE EUROPEAN PINE SHOOT MOTH. Mich. Agr. Expt. Sta. Q. B. 46(2): 186-205. 1963.

Shearing on various dates as a means of controlling the European pine shoot moth in Scotch pine and red pine Christmas trees was studied for 3 years. Since growth response for each date was considered, the bud set and shoot results were also obtained.

Effective control of shoot moth infestation in both over-winter buds and new shoots in Scotch pine was accomplished by shearing July 15 and August 1. Bud set and shoot growth following shearing during this period were entirely adequate for achieving the desired tree growth rate, shape, and density. The usual shearing time currently in use for Scotch pine is from 3 weeks to a month earlier.

In red pine, effective reduction of shoot moth infestation in over-winter buds and new shoots resulted from shearing during the first half of July. Bud set and shoot growth were adequate through the mid-July shearings, but decreased rapidly for later shearings. The usual shearing time currently used for red pine is approximately 10 days to 2 weeks earlier.

Although bud set and shoot growth from delayed shearings will not be at their maximum level, the growth results will still be entirely satisfactory for efficient Christmas tree production, and shoot moth infestation will be practically eliminated. The recommended shearing periods may need to be adjusted somewhat to occur either earlier or later in regions where the growing season differs appreciably in calendar dates from those of the central Lower Michigan area. In general, the latest possible shearing date should be used which will obtain satisfactory (although less than optimum) growth results.

Mich. State U., Agr. Expt. Sta., East Lansing, Mich.

159. Smith, L. F. CONTROLLING SHRUBS ON WET SLASH PINE SITES. U.S. Forest Serv. Res. Note SO-4, 2 pp. 1963.

Cutting stems near groundline and spraying the fresh stumps with 2,4,5-T in diesel oil killed 99 percent of the plants within 2 years, but cost twice as much as a foliage spray with 2,4,5-T in water, which killed 66 percent.

Table.--Percent of sample plants dead 2 years after treatment

2,4,5-T treatment	Cyrilla	Large gall-berry	Common gall-berry	Southern bay-berry	Red maple	Common sweet-leaf	All species
	----------Percent----------						
1. Foliage spray in water	60	84	76	84	20	73	66
2. Foliage spray in water and oil	44	44	68	96	32	93	61
3. Rootcollar spray in oil	56	84	72	96	56	70	72
4. Stem and rootcollar spray in oil	84	88	96	96	84	100	91
5. Stump spray in oil	100	100	96	100	100	96	99
Average	69	80	82	94	58	86	78

Average costs per acre ranged from $24.14 in treatment 1 to $48.24 in treatment 5. The other treatments were intermediate. The major expenditure in all treatments was for materials, but in treatment 5 the labor of brush-cutting added to costs.

Southern Forest Expt. Sta., FS, USDA, New Orleans, La.

160. Roe, E. I., and Buchman, R. G. EFFECT OF HERBICIDE, DOSAGE, AND VOLUME ON HAZEL BRUSH AT DIFFERENT FOLIAR STAGES. Forest Sci. 9(4): 477-484. 1963.

To determine the minimum amount of herbicide required to give adequate control of hazel brush (Corylus americana and C. cornuta), a comprehensive test of foliage spraying with common herbicides was undertaken in northern Minnesota. Treatments consisted of water emulsions of 2 herbicides applied in three dosages and three volumes at five stages of foliar development.

Based on the amount of stem kill and recovery from such injury, it was found that: (1) 2,4-D gave better control than silvex at all growth stages except midleaf when neither was satisfactory; (2) 2 pounds of 2,4-D per acre was definitely better than either 1 pound or ½ pound at all stages except midleaf; (3) dosage was generally linear in its effect, 2 pounds giving practically complete control at the shoot-growth-complete stage; (4) the volume of mixture in which the 2,4-D was applied did not affect the results; and (5) the best control was obtained at the shoot-growth-complete stage; the poorest at midleaf; control was intermediate otherwise.

The recommendations imply complete application of the herbicide solution to the foliage of the hazel brush. In applications from aircraft or with mist blowers, compensation should be made for uneven application and losses due to drift and evaporation.

Lake States Forest Expt. Sta., FS, USDA, St. Paul, Minn.

161. Radwan, M. A. PROTECTING FOREST TREES AND THEIR SEED FROM WILD MAMMALS. (A REVIEW OF THE LITERATURE). U.S. Forest Serv. Res. Paper PNW-6, 28 pp. 1963.

A review of the methods used to control wild mammal damage to forest tree seed, seedlings, and trees was presented. References to mammals causing the damage, their motivation, types of damage, and effect on the forest resource were given.

Measures required to achieve control of wild mammal damage to forest values must be of a much more intensive nature than heretofore contemplated. Costs involved in application of mechanical barriers to animals rule out this approach to the problem on the millions of acres of forest land under consideration. Some help can be expected from cultural measures, intensified trapping, shooting of the larger problem animals, and other direct-action methods, but such efforts are feasible only on relatively small areas.

A review of the literature indicates that a promising approach for the eventual control of wild mammal depredations is the improvement of chemical toxicants and repellents. Contact repellents and toxicants are only a stopgap because they protect only current growth. More effective and longer lasting results will require developing and perfecting the use of truly systemic toxicants or repellents.

Pacific Northwest Forest and Range Expt. Sta., FS, USDA, Portland, Oreg.

162. Wickman, B. E. MORTALITY AND GROWTH REDUCTION OF WHITE FIR FOLLOWING DEFOLIATION BY THE DOUGLAS-FIR TUSSOCK MOTH. U.S. Forest Res. Paper PSW-7, 15 pp. 1963.

In 5 years after a 1954-56 outbreak of Hemerocampa pseudotsugata in Calaveras and Tuolumne Counties, Calif., 20 percent of the merchantable white fir, or 11,071 board feet

per acre, died in heavily defoliated stands. Another 1,113 board feet per acre was lost owing to radial growth reductions in partly defoliated trees; 12 percent of these trees were top-killed. Defoliation alone, and the combined effects of defoliation and attacks of cambium-mining beetles were the main causes of mortality.

Pacific Southwest Forest and Range Expt. Sta., FS, USDA, Berkeley, Calif.

163. Brinkman, K. A., and Phares, R. E. COST OF DIRECT SEEDING SHORTLEAF PINE IN THE MISSOURI OZARKS. Tree Planters' Notes 58: 29. March 1963.

Direct seeding of shortleaf pine (Pinus echinata Mill.) on the Clark National Forest in Missouri cost from $8 to $15 per acre. This is one-half to one-third the cost of planting seedling trees. Six areas totaling 142 acres were seeded in December 1960, and the overstory was poisoned. Sites ranged from old fields to uncut oak stands.

The treated seed was broadcast over each tract by a two-man crew using cyclone seeders. One man carried a spool of light string on his back to mark the seeded zone. Size of the poisoning crew varied from three to five men.

From 1,500 to 6,000 well-distributed pine seedlings were established on all areas direct seeding in 1960, a year with favorable rainfall distribution. Results were not as good in drier years, but during these years planted pine also failed to survive.

Central States Expt. Sta., FS, USDA, Columbia, Mo.

Windbreaks

164. Woodruff, N. P., Fryrear, D. W., and Lyles, L. REDUCING WIND VELOCITY WITH FIELD SHELTERBELTS. Kans. Agr. Expt. Sta. Tech. B. 131, 26 pp. 1963.

Wind velocity data were taken in the open and to the leeward of 15 field shelterbelts to determine their effectiveness in reducing wind velocities. Results were presented in terms of velocity-reduction curves, effectiveness indexes, indicated wind-erosion-protected zones, and an estimated extent of influence 15 years after planting which was based on the rate of growth of the dominant tree species on different soil-site conditions.

It was not so much the number of rows as it was the porosity or density of the barier formed that governs the effectiveness of a shelterbelt. Some single-row belts were more effective than some 3-, 5-, and 7-row belts and conversely some 5- and 10-row belts were more effective than single or 3-row belts. Of the belts tested, the three most effective ones in the summer were: A 2-row mulberry; a 3-row all deciduous; and a 5-row deciduous-coniferous combination. The three best belts in the winter were: A 10-row deciduous-coniferous; a 5-row deciduous-coniferous; and a single-row Osage-orange hedge. Single-row barriers had a high effectiveness index per row of trees--an important attribute if economical use of land and cost are to be considered.

A relative comparison of the velocity-reduction efficiency of several different tree species, made from the summer condition single-row belt effectiveness index data, showed that Osage-orange was the most effective followed by arborvitae, Siberian elm, cottonwood, and jack pine.

Leeward distances which would be fully protected from soil erosion by wind varied from a maximum equal to 33 times the belt height for a 2-row foliated mulberry with a 30-mile-per-hour, 50-foot elevation wind velocity, to zero for 1-row defoliated Osage-orange hedges and 1-row foliated Siberian elm barriers when the wind reached 70 miles per hour. For a 40-mile-per-hour velocity at a 50-foot elevation, the maximum protected length in

terms of barrier heights (H) was 18 H for 2-row foliated mulberry. The Minimum was 8 H for a 1-row foliated cottonwood belt. The average for 10 belts, some foliated and some not, was 12.8 H.

The 15-year expected extent of influence analysis showed that a 5-row foliated belt composed of plum, cedar, mulberry, green ash, and a Siberian elm could be expected to provide the longest distance fully protected from wind erosion on all four soil-site conditions evaluated and for levels of wind velocity ranging from 30 to 70 miles per hour measured at the 50-foot elevation. For winter conditions, a 10-row deciduous-coniferous combination provided the longest protected length. A single-row foliated cottonwood because of its more rapid rate of growth would provide the third longest extent of influence on soil sites to which it is adapted and under conditions of wind velocity less than 40 miles per hour. Shelterbelts composed entirely of coniferous species were generally found too dense and too slow-growing to provide an ideal wind barrier. However, their use, if properly spaced or trimmed to provide porosity near the ground, was indicated in combination with deciduous trees.

Data given for distances protected from wind erosion and for growth potential of trees were used in conjunction with different levels of open wind velocity to demonstrate how the required planting interval for a system of shelterbelts can be determined. Examples were worked out for two different soil sites for a summer and a winter condition, 5-row deciduous-coniferous combination having a Siberian elm as the dominant species. The spacing interval was shown to vary from 151 feet for the winter belt on C-1 (shallow upland) soil sites with 50-mile-per-hour, 50-foot elevation winds to 707 feet for the summer belt on A-1 (river valleys) sites with 30-miles-per-hour, 50-foot elevation winds.

Agr. Expt. Sta., Kans. State U. Agr. and Appl. Sci., Manhattan, Kans.

165. Smith, M., and Miles, W. PLANTING TREES FOR FARMSTEAD SHELTER. Minn. Agr. Ext. Serv. Ext. B. 196, 16 pp. 1963.

Information on what factors to consider when establishing a new shelterbelt or renovating an old one was given. How to plan, plant, and establish this valuable asset on the farm was given.

A good farmstead shelterbelt will: (1) Reduce the effects of cold, piercing winter winds on humans and animals. (2) Moderate the effects of hot, dry, searing summer winds. (3) Beautify the home and farmstead, making them more attractive places to live. (4) Prevent snow from drifting around buildings, roads, and walks. (5) Save fuel - up to 30 percent in many homes. (6) Cut down feed costs. Cattle protected against winter winds use feed for weight gain and not merely to keep warm. (7) Protect feedlots, gardens, and orchards. And (8) aid in establishing lawn and landscape plantings. The authors concluded that:

1. Thorough ground preparation before planting assures good survival and sustained growth.
2. Proper location of a shelterbelt in relation to prevailing stormwinds is of utmost importance. Usually it should be located on the north and west sides of the farmstead.
3. Selecting trees and shrubs that are of proven hardiness and suited to the soil, climate, and purpose is always essential.
4. Proper spacing of trees within and between rows assures early results and longtime service.
5. Regular cultivation of trees during the growing season to eliminate weeds and grass and to conserve moisture is a "must."
6. Protection of the windbreak from livestock, rabbits, and other rodents is necessary.

7. Early recognition of insect and disease damage, with proper steps taken for control, pays dividends.
8. Renovation of deteriorating, overage groves can be done by replanting and relocating to restore protection.

U. Minn., Agr. Ext. Serv., St. Paul, Minn.

Management of Coffee Plantations

166. Boyce, D. S. MEJORES METODOS PARA EL BENEFICIADO DEL CAFE EN FINCAS DE TAMANO MEDIANO. P. R. Agr. Expt. Sta. B. 165, 26 pp. 1963. (From English Summary).

The processing of fresh coffee cherries to dried parchment was discussed and present processing practices, with particular reference to the medium-sized farm, were described. The disadvantages of these systems were: (1) A great amount of time and labor was expended in moving material about during the processing cycle; and (2) the methods of drying either naturally or artificially were unsatisfactory. Natural drying was expensive in terms of labor, and unreliable because of its dependence on the weather. The artificial driers used were expensive in their initial cost, difficult to operate, and worked at such high temperatures that the resulting product was not of high quality.

The problem of transferring the coffee during the processing cycle was overcome by suitably locating a materials-handling pump with the appropriate valves, and also by making use of gravity. A two-stage drying system utilizing standard grain-drying equipment was found satisfactory. In the first stage or predrier, ambient air was drawn downwards through a bed of skin wet parchment, first removing the free water and then commencing to dry the parchment itself. From the predrier the parchment was moved mainly by gravity to a second stage, or main drier. Here it was completely dried in a thin layer by blowing heated air upwards through it.

A somewhat modified grain-drying unit consisting of an 18-inch-diameter axial flow-fan coupled with a 12-kw. electric heater was used. The drying-air temperature was not allowed to exceed 120° F. and the drier could be left safely to operate unattended. With this equipment, 12 to 15 hundredweights of dried parchment was produced in approximately 24 hours. Drying was the limiting factor in the processing cycle.

Factors that determine the cost of processing were discussed and an example of a budget using realistic cost data was given. Various aspects of the steps which can be taken to reduce the labor requirements for processing by simplifying the layout of the equipment, and by adapting certain labor-saving devices were discussed. The simple maintenance requirements for this processing equipment were outlined.

U. P.R., Agr. Expt. Sta., Rio Piedros, P.R.

Fruit and Nut Crops

SEE ALSO 10, 48, 52, 141, 277, 290.

Maxwell, N. P., and Bailey, M. A. eds. GUIDE FOR CITRUS PRODUCTION IN THE LOWER RIO GRANDE VALLEY. Tex. Agr. Expt. Sta. B. 1002, 57 pp. 1963.

This guide for citrus production in the home Rio Grande Valley of Texas contains the following articles:

167. Maxwell, N. P., Petersen, R., Orton, R., and Haddock, D. VALLEY CITRUS AND ITS POTENTIAL.

771-426 O-65—7

168. Bailey, M. A., Maxwell, N. P., Carter, D. L., and Haddock, D. SELECTING A SITE.

169. Myers, V. I., Ross, P. E., and Carter, D. L. IRRIGATION, SALINITY, AND DRAINAGE.

170. Olson, E. O., Young, R., Bailey, M. A., Maxwell, N. P., Cooper, W. C., and Lime, B. KINDS OF CITRUS AND THEIR VALUE.

171. Sleeth, B., and Bailey, M. A. NURSERY TREES.

172. Bailey, M. A., and Maxwell, N. P. GROVE ESTABLISHMENT.

173. Bailey, M. A., Maxwell, N. P., Sleeth, B., Dean, H., Gerard, C., and Bloodworth, M. CARE OF BEARING TREES.

174. Haddock, D. J. AGRICULTURAL METEOROLOGY FOR CITRUS PRODUCTION.

175. Young, R., Hobgood, P., Maxwell, N. P., and Haddock, D. COLD PROTECTION.

176. Sleeth, B., Maxwell, N. P., Bailey, M. A., and Young, R. CARE AND REHABILITATION OF FREEZE-DAMAGED CITRUS TREES.

177. Sorensen, H. B., Lime, B., Powell, G., Petersen, R. MARKETING TEXAS CITRUS.

178. Petersen, R., and Kennedy, R. COSTS AND RETURNS OF PRODUCING TEXAS CITRUS.

Tex. A&M U., Tex. Agr. Expt. Sta., Tex. Agr. Ext. Serv., College Station, Tex.

179. Tiscornia, J. R., and Larsen, F. E. ROOTSTOCKS FOR APPLE AND PEAR: A LITERATURE REVIEW. Wash. Agr. Expt. Sta., Sta. C. 421, 45 pp. 1963.

French Crab Seedling (frequently used synonymously with domestic seedlings) stocks for apples offer the advantages of cheap propagation, great vigor induction, good compatibility with commercial varieties, and good anchorage. The main disadvantages of French Crab are induction of later fruit production, excessive tree size in good soils, susceptibility to wooly aphid, and some lack of resistance to low temperatures.

Trials with apomictic apple seedling rootstocks are relatively recent. Some of these stocks are promising because of their uniformity from seed and their dwarfing tendency.

The East Malling (E.M.) series are the better tested clonal apple stocks in regard to control of tree size. In general, the relative position of the members of this series has not been changed substantially after about 40 years of trials.

The more outstanding advantages of the E. M. stocks are their clonal nature, control of tree size, and early fruiting induced by several of them. Compatibility with apple varieties and propagation ease do not appear to be problems when using these stocks. Yield per acre in comparison with other stocks must be examined for every stock-scion combination under local conditions. Cold resistance of E. M. stocks appears to be satisfactory in areas where low temperatures are not extreme. The main disadvantages of the E. M. stocks are poor anchorage of several dwarfing and semi-dwarfing members of the series, suckering, and their marked susceptibility to wooly aphid. Some are also susceptible to crown rot.

The Malling Merton (M.M.) stocks are outstanding for their wooly aphid resistance. They are also vigor-controlling stocks ranging from semi-dwarf to standard size inducing. Some of the M. M. stocks are promising because of their influence on tree size, early bearing, and yield. Anchorage of the M. M. stocks is in general better than that of the dwarf and semi-dwarf E. M. stocks. As a general rule, these stocks sucker less than the E. M. series.

Northern Spy is a wooly aphid-resistant stock which has some dwarfing and early bearing influence on apple varieties. It is highly susceptible to drought and somewhat poorly anchored.

The new Malling IX crosses have not been generally released by East Malling but could be a valuable material for the fruit industry in the future. They are size controlling stocks covering a wider range than the E. M. series. Some of them fill gaps in vigor induction between two E. M. stocks. Anchorage has been improved in several of them. Suckering seems to be the main disadvantage of many of them.

Winter hardy stocks are required where very low temperatures occur. Robusta No. 5, Antonovka, Charlamoff, Columbia Crab, Haralson, and the Kansas selection, K-41, appear to be promising hardy stocks.

French pear seedlings (frequently used synonymously with domestic seedlings) are still valuable material when standard trees are required. Uniformity of the tree, compatibility with pear varieties, and good anchorage are satisfactory characteristics derived from the use of these stocks. Fire blight susceptibility and excessive tree size can be important factors when seedlings are used under certain conditions.

Most of the so-called oriental pear stocks are being eliminated from the pear industry in America because of their susceptibility to hard end and pear decline.

Old Home is a promising stock or interstock for pears because of its blight resistance, apparent pear decline resistance, and other desirable characteristics.

Quince stocks are outstanding for their dwarfing and early bearing effects. Incompatibility with some pear varieties, poor anchorage, winter hardiness, and fire blight susceptibility are important problems with quince stocks.

Quince A seems to be the more promising quince stock for pears at present.

Bibliography.

Wash. Agr. Expt. Sta., Inst. Agr. Sci., Wash. State U., Pullman, Wash.

180. Bramlage, W. J., and Thompson, A. H. EFFECTS OF REPEATED BORON SPRAYS ON MATURITY AND STORAGE LIFE OF JONATHAN APPLES AND ON CARBOHYDRATE CHANGES AND ENZYME ACTIVITY IN THE FRUITS. Md. Agr. Expt. Sta. B. A129, 42 pp. 1963.

In 1961, Jonathan apple trees were sprayed early in the season, beginning during blossoming, with 3 or 6 sprays of boric acid, applied at the rate of 1 lb. per 100 gallons of water. Three harvests of fruits were taken, and samples were stored for 0, 7, and 15 weeks at 34° F. At the end of each storage period, the fruits were examined and sampled for laboratory analyses. In 1962, Jonathan apple trees again were sprayed early in the season with 3 or 6 sprays of boric acid. Six harvests of fruits were taken from each tree over a period of 24 days. These fruits were not stored as they were examined immediately and sampled for analyses. The authors concluded that:

1. In the 2 years, mature untreated fruits contained 24 and 25 p.p.m. of boron (B), those sprayed 3 times with boric acid contained 52 and 53 p.p.m., and those sprayed 6 times contained 92 and 96 p.p.m.

2. Six sprays of boric acid resulted in: (1) Earlier coloring of apples. (2) Stimulation of the development of water core in the fruits. Considerable amounts of water core were present even at the earliest harvests, and the disorder continued to develop during storage. (3) Increased incidence of internal breakdown of fruits following storage. Breakdown quite frequently developed in tissues previously affected with water core. (4) Increased fruit decay following storage. (5) Slower rate of softening of apples during maturation and storage. (6) Stimulation of pectinmethylesterase (PE) activity. A possible relationship between the effects of B on PE and on fruit firmness was discussed. (7) Evolution of CO_2 from the fruits at a higher rate following 15 weeks of storage. And (8) reduction of the total alcohol-insoluble solids in the fruits. This was in part due to a reduction of starch.
3. There was no pronounced effect of the B sprays on: (1) Incidence of Jonathan spot on the apples; (2) moisture content of the fruits; (3) CO_2 evolution from the fruits at the time of harvest; and (4) activity of polyphenoloxidase, catalase, phosphatase, phosphorylase, or amylase in the fruits.
4. Most of the results indicated that excessive sprays of B resulted in earlier maturation of the fruits. The marked reduction of storage life following the sprays probably was to a great extent the result of earlier maturation.
5. During maturation of the fruits, significant changes in enzyme activity were detected. (1) Polyphenoloxidase and peroxidase activities followed the same pattern; they decreased at optimum maturity and then increased at the postoptimum stage of maturity; (2) catalase activity rose very sharply during the preoptimum period, decreased during the optimum period, and increased again during the postoptimum period; (3) phosphatase activity rose very sharply during the postoptimum period; (4) amylase activity decreased somewhat until optimum maturity and increased into the postoptimum period before decreasing during overmaturity.
6. During storage of the fruits, significant changes in enzyme activity were detected: (1) PE activity increased with increasing time in storage; (2) catalase activity increased greatly during the first 7 weeks of storage, then decreased sharply during later storage; and (3) peroxidase activity increased during storage of B-sprayed apples, but not in the untreated fruits.

U. Md., Agr. Expt. Sta., College Park, Md.

181. Purcell, J. C., and Elrod, J. C. PRACTICES AND COSTS IN ESTABLISHING AND MAINTAINING PECAN GROVES IN GEORGIA. Ga. Agr. Expt. Sta. Mimeo Ser. N. S. 180, 24 pp. 1963.

Practices and costs of establishing pecan orchards to 11 years of age were given along with the practices and costs of maintaining producing orchards over 11 years old. Costs were based on the cost of physical inputs for the calendar year 1961.

Analysis of costs and returns for the pecan enterprises was confounded by interplanting of other crops on the same acreage and an indefinite termination date for pecan groves. Annual returns from producing pecan groves were highly variable due to variation in both yields and prices. Costs over time varied largely with changes in the price level of inputs and changes in production technology.

Practices in establishing pecan groves during the year of planting consisted of breaking land, laying off rows, and planting trees. Additional practices during establishment consisted of fertilizing, cultivating, and pruning. Most of the acreage of pecans was both

cultivated and fertilized annually from the 2nd through the 11th year. A large proportion of the acreage from 2- through 8-year-old groves was pruned.

The usual costs were about $42 per acre in the year of planting. This included cost of preparing land, trees, and setting trees. Annual costs for groves from the 2nd year through the 11th year ranged from about $15 to $20 per acre. These costs were largely for fertilizing and cultivating. In terms of inputs, a land charge of $8.50 per acre per year accounted for about 40 percent of the establishment cost. Other inputs were: Fertilizer material--16 percent; equipment charge--12 percent; trees--11 percent; and labor--10 percent.

Total net costs through 11 years were estimated at $172 per acre. The cost, accumulated over the 11 years of establishment at 4 percent interest compounded annually, amounted to an investment of $224 per acre.

Annual costs to maintain producing (from the 11th year through life of trees) pecan groves in Georgia, based on 1961 costs for inputs, were estimated at $45 per acre.

Returns per acre from producing groves, based on yield data for the Stuart variety and 1961 prices, were $34 for 10- to 18-year-old trees and $74 for 19- to 27-year-old trees inclusive. At the end of 27 full years, total returns would exceed all imputed costs except liquidation of the original investment by about $165 per acre.

At 1961 prices, yields of 136 pounds per acre were necessary to cover annual imputed costs.

Ga. Agr. Expt. Sta., U. Ga. Col. Agr., Experiment, Ga.

182. Burke, G. M., and James, S. C. SOME ECONOMIC ASPECTS OF THE MARKETING OF PECANS IN NEW MEXICO. N. Mex. Agr. Expt. Sta. Res. Rpt. 82, 13 pp. 1963.

Pecan growers in Dona Ana and Eddy Counties in New Mexico were interviewed in the fall of 1961 for information about their production and marketing practices. Questionnaires were obtained from 16 growers. These growers handled 97 percent of the 8 million pounds of pecans marketed in New Mexico during 1960 and approximately 96 percent of the total marketings were by three of the growers. The growers reported 89,310 producing pecan trees in their orchards occupying 4,218 acres, or approximately 21 trees per acre with the most common planting pattern being 30 X 60 feet. The two most important varieties of improved pecans in New Mexico are Western Schley and Bradley. The survey information was supplemented with secondary time series data published by U.S. Department of Agriculture.

Of the 195,000 pecan trees in New Mexico, more than 93,500 were less than 7 years old and the pecan growers indicated that they will plant an additional 75,000 trees in 1963 and 1964.

The average yield of pecans per tree in New Mexico (56.3 pounds) was more than double the United States average yield per tree (21.2 pounds) in 1959.

At a price of 35 cents a pound for the nuts, the grower with a small orchard needed a yield of 19 pounds of pecans per tree to cover the labor and machinery cost for the preharvesting practices ($1.38 per tree); the cost of commercial fertilizer, water, and insecticides ($2.62 per tree); and the cost of harvesting the nuts ($2.59 per tree). Growers with large orchards had preharvesting costs of $1.59 per tree for labor and machinery; $2.53 per tree for commercial fertilizer, water, insecticides; and $2.58 per tree for harvesting costs. These growers also needed a yield of 19 pounds of nuts per tree to cover these costs.

Agr. Expt. Sta., N. Mex. State U., University Park, N. Mex.

SEE ALSO 12, 17, 20, 21, 22, 23, 25, 27, 40, 41, 42, 46, 48, 50, 54, 71, 77, 78, 84, 87, 89, 90, 92, 93, 98, 100, 104, 105, 108, 109, 111, 114, 142, 143, 212, 230, 231, 237, 240, 244, 291, 292, 293.

183. Nelson, C. E., and Roberts, S. EFFECTS OF METHODS OF SPACING FIELD CORN AT 17,900 PLANTS PER ACRE ON GRAIN YIELDS AND STALK BREAKAGE. Wash. Agr. Expt. Sta., Sta. C. 414, 7 pp. 1963.

Five commercial corn hybrid varieties were grown at 17,900 plants per acre with certain spacing methods to study the effects on yields, stalk breakage, and related plant measurements. The spacing methods were: Drilled and hill-dropped in 38-inch rows; drilled in 22-inch rows; drilled in double rows; and drilled in triple rows. In the latter two, the rows were 8 inches apart, with 30 and 22 inches between the double and triple rows, respectively.

The yields of corn for the drilled 22-inch rows, double, or triple rows averaged 9.5 bushels per acre more than the 38-inch drilled, or 38-inch hill-dropped methods. There was no variety interaction.

The plant spacing methods had no significant effect on ear height, stalk height, or stalk breakage.

There was no significant difference in stalk diameter between the drill and hill-drop methods. The 22-inch drill method resulted in larger diameter stalks than the double or triple-row spacing methods. Stalk diameter did not correlate with stalk breakage.

One hybrid variety produced 147.2 bushels per acre. The other four ranged from 112.3 to 116.5 bushels per acre. The small differences among varieties in stalk diameter, ear height, and stalk height were not significantly correlated with stalk breakage. The yield of corn was correlated with stalk breakage, which was due to the high yield of the D4 variety. When all other factors were equal, the stalks with the heaviest ears exerted more force on the leverage of the stalks when whipped in the wind.

Wash. Agr. Expt. Sta., Inst. Agr. Sci., Wash. State U., Pullman, Wash.

184. McManus, B. R., Curtis, W. C., White, M., Cope, J. T., Jr., and Moore, G. D. PRODUCTION AND MARKETING OF CORN IN NORTHERN ALABAMA. Ala. Agr. Expt. Sta. B. 349, 24 pp. 1963.

A study was made to: (1) Determine the typical utilization pattern of corn produced in northern Alabama; (2) estimate the potential for corn production in northern Alabama; and (3) compare the relative advantages and disadvantages of producing corn for farm use and/or for sale. A prepared questionnaire was used in a personal interview with 290 farmers who were selected by use of an area sampling technique. Secondary data were obtained from the Alabama Crop Reporting Service and from various research studies and reports.

During the past decade, corn yields in northern Alabama have doubled and acreage has been reduced almost half.

The demand for corn in this area is approximately twice the local supply. Farmers who have low costs per unit of production are in a favorable position to benefit from corn production.

In 1960, northern Alabama farmers sold approximately 30 percent of the corn they produced. The corn sold was primarily nongraded, yellow, early corn and most sales were to grain dealers during the harvest season. Of the corn remaining on farms, a large proportion was fed to hogs.

From the standpoint of price, November was the best time to buy local corn during the period 1952-61. The lowest price for corn occurred 8 out of 10 years in November. The peak price received for corn did not occur regularly during a specific month. However, the highest average price was in June. During each of the 10 years, the price change between November and the following June was equal to or greater than variable costs of storage.

Farmers who produced corn thought it more advantageous to feed grain to livestock than to sell it as cash grain.

The authors concluded that:

1. Quantities of corn utilized in northern Alabama have been increasing and are expected to continue to increase.
2. Few farms in northern Alabama had storage that was adequate for protecting corn from rodents and insects and for preserving quality. Many farmers in this area would find it advantageous to provide adequate storage to maintain quality of corn.
3. At present there was no apparent need for grain brokers in this area.
4. Indications were that present volume of grain produced in northern Alabama was insufficient to warrant large-scale commercial storage other than the elevators handling imported corn.
5. Feeding corn to livestock and poultry resulted in greater net returns than selling corn as cash grain.
6. It was anticipated that corn acreage in the area will continue to decline and that corn will be grown primarily on farms having low production costs per bushel and/or farms with grain and livestock enterprises.
7. Many farmers in northern Alabama could achieve greater production efficiency and increase returns from corn by using land and other resources available and adopting known technology. The use of recommended practices would make corn production a profitable enterprise on many farms.

Agr. Expt. Sta., Auburn U., Auburn, Ala.

185. Andrew, R. H., Arawinko, Z. M., Love, J. R., and Peterson, A. E. POPULATION FERTILITY AND VARIETAL RESPONSES FOR CONTINUOUS CORN WITH MINIMUM TILLAGE. Wis. Agr. Expt. Sta. Res. B. 244, 20 pp. 1963.

Corn cultural trials evaluating population, fertility, and varietal responses of continuous corn with minimum tillage were conducted for 5 years (1958-62) on Waupun sil soil near Arlington, Wis. In addition to yield, moisture percentage, barrenness, ear weight, shelling percentage, broken stalks, and tillering were measured.

In each year except 1962, six hybrids ranging from 95 to 120 day relative maturity were included in these trials.

The average soil test for the area was originally: pH 6.5-7.0, phosphorus 30-50, potassium 160-190, organic matter 3-3.5 percent, and boron 2 pounds per acre. Three fertility levels, referred to as F_1, F_2, and F_3, respectively, were used in these studies. Fertilizers applied were as follows: F_1--225 pounds per acre of 3-12-12 starter; F_2--225 pounds per acre of 6-24-24 starter 150 pounds per acre of ammonium nitrate; and F_3--225 pounds per acre of 6-24-24 starter 300 pounds per acre of ammonium nitrate. In 1961 and 1962, plots under the F_3 fertility treatment received an additional 225 pounds per acre of 6-24-24 broadcast prior to plowing. The author concluded that:

1. The intermediate (F_2) and moderately high (F_3) fertility levels produced significantly greater yields at all populations than did the low (F_1) level.

2. In terms of population effects on yield, increasing stands above 13,000 plants per acre gave no advantage when a low fertility level (F_1) was maintained--yield was usually reduced. At the F_2 fertility level, populations above 13,000 plants per acre still showed no advantage. However, greater stand densities at this fertility level did not reduce yields except at the 22,000 level. At the F_3 fertility level, except in 1958 and 1959, yields increased significantly at all populations above 13,000 plants per acre. However, yield differences between the 16,000, 19,000, and 22,000 populations were not significant.
3. The short season hybrids performed relatively better at the low fertility level while those of longer season benefited more from increasing fertility except in dry years. On the average, the early maturing hybrids profited more with increasing population, especially in the high moisture year of 1960.
4. There was a slight but definite trend toward higher ear moisture at harvest with higher populations. There was also a tendency for more rapid maturity at the F_2 fertility level as compared with maturity at the lower and higher levels.
5. Barrenness increased consistently with population increase from 6.9 percent at the 13,000 population to 9.9 percent at 22,000 on a 5 year basis. Increasing fertility decreased barren plants from an average of 11.7 percent at the F_1 level to 6.9 percent at the F_2 level. Barrenness also tended to be higher for longer season hybrids, especially at the lower fertility level and at the higher populations.
6. Average ear weights were lower with higher populations and higher with greater fertility. While ear weights were about the same for hybrids of all maturities at low fertility, at higher fertilities, the later hybrids produced higher ear weight in moist years and for the 5 year average.
7. Shelling percentage decreased with greater plant densities and increased with fertility and available moisture. The earlier maturing hybrids showed higher percentages.
8. Stalk breakage increased with plant density and increased fertility. The early and late maturing hybrids showed the highest percent breakage.
9. Under 5 years of continuous corn, using minimum soil tillage methods and returning all corn stover to the field, soil tilth was not injured and may actually have been improved.

Agr. Expt. Sta., U. Wis., Madison, Wis.

186. Stickler, F. C., and Pauli, A. W. YIELD AND YIELD COMPONENTS OF GRAIN SORGHUM AS INFLUENCED BY DATE OF PLANTING. Kans. Agr. Expt. Sta. Tech. B. 130, 15 pp. 1963.

Grain yields and individual components of yield (heads per unit area, seeds per head, and seed weight) were evaluated for eight grain sorghum varieties planted May 20, June 10, and June 30 (1958-60) and these plus May 1 in 1961-62. Trials were conducted at Manhattan, Kans., on a fertile bottomland site.

In each of the 5 years, either significant (.05 level) or highly significant (.01 level) differences among planting dates, varieties, and variety date interaction were found for grain yield and for individual components of yield, indicating little difference in their tendency to exhibit variety date interaction. Varietal response to planting date was generally associated with varietal maturity. Highest yields were obtained from the May 1 and May 20 plantings, with little benefit from the May 1 over the May 20 date. Several instances of very strong variety planting date interaction were noted. Yield depression from delayed planting

was most closely associated with a decrease in the number of seeds per head and with a small number of heads per unit area; and least associated with seed weight.

Simple and partial correlation coefficients were used to evaluate the degree of association between yield and individual yield components and among yield components. Consistently high correlations between yield and number of seeds per head were noted. Yield was significantly correlated (simple "r") with heads per unit area only in 1959. The partial "r" between yield and heads per unit area, holding both remaining components constant, however, was significant 4 of the 5 years.

Only a few significant interrelationships among individual yield components were detected. Heads per unit area vs. seeds per head, heads per unit area vs. seed weight, and seeds per head vs. seed weight were significantly correlated only in two, one, and three of five tests, respectively.

The desirability of developing management practices that will facilitate earlier planting of grain sorghum in the eastern portion of the Great Plains was indicated. Certain genotypes and maturity classes formerly considered too late may have a place in early-planted grain sorghum culture.

Agr. Expt. Sta., Kans. State U., Manhattan, Kans.

187. Bolton, F. E., Curtis, B. C., and Schlehuber, A. M. GRAIN PRODUCTION CHARACTERISTICS OF FIVE WINTER OAT VARIETIES. Okla. State U. Expt. St. B. B-613, 12 pp. 1963.

A study was made at Stillwater and Woodward, Okla., during 1959-60 to determine the effects of different environments on five winter oat variety yields and components of yield (number of seeds per panicle, number of panicles per unit area, and weight per seed). Height, maturity, and test weight were also included in the trials.

Number of panicles per unit area showed an increase relative to yield and was influenced most by different environments. There were highly significant variety X location, variety X year, and year X location interactions. There was a significant variety X location first order interaction for number of seeds per panicle and weight per seed, with the latter component having the smaller variances.

Varietal rank in number of seeds per panicle closely parallelled the yield ranking, suggesting that this component was most important in determining yield. Varietal rank may also be useful as a selection criterion for higher yielding varieties.

The wide range of maturity of varieties apparently had little effect on yield, since the highest yielding varieties were represented by extremely early, medium, and extremely late varieties.

Okla. State U. Expt. Sta., Stillwater, Okla.

188. Nelson, C. E., and Roberts, S. EFFECTS OF PLANT POPULATIONS AND TIME OF SEEDING ON THREE VARIETIES OF DURUM WHEAT. Wash. Agr. Expt. Sta., Sta. C. 420, 10 pp. 1963.

The durum wheat varieties Wells, Sentry, and Lakota were grown at 8, 18, and 30 plants per square foot in a split-plot design with four replicates. These were seeded March 8, March 27, and April 13.

The number of culms per plant decreased with increasing plant population. The date of seeding had little effect on tillering, except that at eight plants per square foot the wheat seeded March 8 averaged one culm more per plant than that seeded on April 13.

Varietal differences in plant height and lodging were not statistically significant. The average lodging of the varieties was 82 percent.

Plant lodging increased with plant population density. The plants from the April 13 seeding lodged more than those seeded March 8 and March 27.

Grain yields from seeding on March 8 were significantly higher than from March 27 or April 23 seedings. The latter two did not differ significantly (P = .05).

The average yields from the 3 seeding dates with 8 and 18 plants per square foot were the same (74.2 bushels per acre). With 30 plants per square foot, the yield was 69.0 bushels per acre. There was no interaction of plant population with either varieties or time of seeding in yields of grain.

The bushel weights for the plant population treatments ranged from 60.3 to 61.5 pounds.

The 1000-kernel weight was less than 30 plants per square foot than with 8 or 18 plants per square foot. The kernel weight decreased with progressively later dates of seeding.

Lakota averaged 77.5, Wells 74.2, and Sentry 65.7 bushels per acre. Lakota had a higher bushel weight, kernel weight, and protein content than the other two varieties.

Wash. Agr. Expt. Sta., Inst. Agr. Sci., Wash. State U., Pullman, Wash.

189. Nelson, C. E., and Roberts, S. SPRING WHEAT VARIETY, POPULATION, AND PLANTING DATE EXPERIMENT. Wash. Agr. Expt. Sta., Sta. C. 419, 13 pp. 1963.

Seven varieties of spring wheat with a wide range of maturity were grown in a randomized split-plot design experiment with four replications on March 8, March 27, and April 13 with 9, 20, and 31 plants per square foot.

It took the wheat seeded March 8, 18 days to emerge, the March 27 seeding 14 days, and the April 13, 7 days to emerge. The soil temperatures at seeding depth averaged 45°, 50°, and 61° F. respectively, for the three time periods.

Tillering decreased with increasing plant population. The tillering was not significantly different for all plant populations and seeding dates except at 9 plants per square foot. At this spacing, the wheat seeded March 8 produced about 1 culm per plant more than for the other 2 seeding dates at the same plant population.

The tillering of the varieties was not greatly different, ranging from 4.04 to 4.59 culms per plant with no interactions with seeding date, or plant population.

Plant height for the April 13 seeding was 45.8 inches compared with 47.4 and 48.1 inches for the March 8 and March 27 seedings. Plant population had a minor effect on plant height, being less than 1 inch. The average plant height for the varieties ranged from 45.1 to 49.9 inches.

Lodging increased with plant population. With nine plants per square foot, the lodging was nearly the same for the three seeding dates. At 20 and 31 plants per square foot, the lodging was the same for March 8 and March 27, and considerably less for the April 13 seeding.

The average yields for all varieties and plant populations were 85.9, 75.7, and 69.8 bushels per acre for the March 8, March 27, and April 13 seeding dates, respectively.

The average yields for 9, 20, and 31 plants per square foot were 77.8, 78.3, and 75.3 bushels per acre.

Table Average yields from three seeding dates for the varieties and plant populations

Variety	C.I. No.	Plants per square foot 9	20	31	Variety average
		bu./a.	bu./a.	bu./a.	bu./a.
Idaed 59-B	13632	78.3	80.8	68.6	75.9
Oni	13635	75.6	76.9	74.7	75.7
Eli	13636	82.2	83.0	82.1	82.4
Gabi	13637	78.8	85.3	86.2	83.4
Marfed	11919	75.5	76.3	73.9	75.2
Pilcraw	5540	64.0	62.8	57.6	61.5
Idaed	11706	90.0	83.3	83.9	85.7

L.S.D. (5%) Varieties 6.5, plants per sq ft varieties 4.8 C.V. 7.7%

The average bushel weight for Pilcraw was 58.3 pounds; the other six varieties ranged from 60.7 to 61.2 pounds. Seeding date and plant population had minor effects on bushel weight, the greatest difference being 0.6 pound per bushes. The average for the treatments was 60.7 pounds per bushel.

Wash. Agr. Expt. Sta., Inst. Agr. Sci., Wash. State U., Pullman, Wash.

190. Abernathy, G. H. COMPARISONS OF MACHINE COMPONENTS FOR PLANTING COTTON. N. Mex. Agr. Expt. Sta. B. 477, 18 pp. 1963.

The results of three experiments were reported. The first of these was a planter component test in which six combinations of soil manipulation components were compared. These components included standard and compression-type openers, seed firming wheel, rubber-tired and steel surface press wheels, and a capping attachment. The second experiment pertained to dates and methods of planting. Seed was planted, capped or not capped, on April 1, 15, 30, and May 15. The third experiment was a comprehensive planting experiment in which two soil openers, three planting depths, seed press wheels with various weights, and surface press wheels with various weights were compared in all combinations. The author concluded that:

1. Planter Component Experiment--good stands were consistently obtained with the capping method of planting. The use of an open-centered steel press wheel resulted in acceptable stands without the soil cap, and no harrowing was needed to remove the soil cap. Where a rubber press wheel was used, significantly better stands were obtained by harrowing after planting as compared to not harrowing the plots. Harrowing had no effect on plots planted with an open-centered press wheel.
2. Date of Planting Experiment--no consistent significant difference was obtained between stands planted on April 1 and 15. Emergence was more consistent and faster in stands planted on April 15 or later than in those planted April 1. Yield from the

April 15 plantings was not significantly lower than from the April 1 plantings. Yields were significantly lower from the April 30 or May 15 plantings. Fiber properties were unaffected by planting date.

3. Comprehensive Planting Experiment--2 inches was the best depth of planting under the conditions of the 1958 season. The experimental soil compression opener did not result in significantly better stands than the conventional curved runner opener. When seed was planted at shallow depths, stands were better where a seed firming wheel and an extra weight on the surface press wheel were used than where they were not used. When seed was planted 3 inches deep, stands were lower with the seed firming wheel and extra weight on the surface press wheel than without these components.

Agr. Expt. Sta., N. Mex. State U., University Park, N. Mex.

Roussel, J. S., and Baker, B. J. LOUISIANA COTTON PRODUCERS HANDBOOK. La. Agr. Expt. Sta. and Agr. Ext. Serv. Handbook, Unnumbered. 45 pp. 1963.

The Louisiana Cotton Producers Handbook presents to the cotton industry a general picture of the many complex practices that must be followed for effective cotton production. The following articles were given:

191. Roussel, J. S., and Baker, B. J. INTRODUCTION.

192. Wiegmann, F., and Woolf, W. THE ECONOMICS OF PLANNING A FARM PROGRAM AROUND COTTON.

193. Jones, J. E. THE GROWTH AND FRUITING HABITS OF THE COTTON PLANT.

194. Wimberly, J. LAND FORMING FOR COTTON PRODUCTION.

195. Saveson, I. L., and Patrick, W. H., Jr. DEEP TILLAGE FOR COTTON.

196. Thomas, C. H., Oakes, J. Y., and Hendrix, J. A. SEEDBED PREPARATION.

197. Sturgis, M. B. FERTILIZER RECOMMENDATIONS FOR COTTON IN LOUISIANA.

198. Thomas, C. H., Standifer, L. C., Jr., and Smilie, J. L. PLANTING EQUIPMENT AND METHODS.

199. Self, F. W. COTTON VARIETIES FOR LOUISIANA.

200. Jones, J. E. VARIETIES FOR FUSARIUM WILT-NEMATODE INFESTED SOILS.

201. Birchfield, W. NEMATODES ON COTTON IN LOUISIANA.

202. Sinclair, J. B. DISEASES OF COTTON IN LOUISIANA.

203. Thomas, C. H., Standifer, L. C., Jr., Sloane, L. W., Melville, D. R., Smilie, J. L., and Bingham, S. W. WEED CONTROL IN COTTON.

204. Clower, D. F. CONTROL OF COTTON INSECT PESTS.

205. Wimberly, J. COTTON IRRIGATION PRACTICES.

206. Standifer, L. C., Jr., Thomas, C. H., and Porter, W. K., Jr. THE CHEMICAL DEFOLIATION OF COTTON.

207. Smilie, J. L., Thomas, C. H., and Standifer, L. C., Jr. HARVEST COTTON WISELY.

208. Severance, C. E. COTTON GINNING.

209. Hudson, J. F. COTTON AND COTTONSEED MARKETING.

210. Finley, L. THE MANY USES OF COTTON.

Agr. Expt. Sta. and Agr. Ext. Serv., La. State U. and Agr. and Mech. Col., Baton Rouge, La.

211. Shaw, L., and Gossett, D. M. RATE OF SEEDING IN BURLEY TOBACCO PLANT BEDS AS IT AFFECTS STAND DENSITY, NUMBER, AND TYPE OF TRANSPLANTS PRODUCED, AND FIELD PERFORMANCE. N.C. Agr. Expt. Sta. Tech. B. 159, 26 pp. 1963.

The emergence and performance of burley tobacco seedlings in plant beds at seeding rates of 1/32, 1/16, 1/8, 1/4, 3/8, 1/2, 5/8, 3/4, and 1 ounce of seed per 100 square yards were studied at Waynesville, N.C., from 1954-58. Field performance of transplants produced from the seeding rates of 1/16, 1/4, and 3/4 ounce was studied from 1956-61. The author concluded that:

1. The number of plants which emerged increased as the seeding rate was increased; however, the percent of seed producing seedlings decreased as the seeding rate was increased.
2. The number of plants suitable for transplanting in each of the three pullings increased as the seeding rate was increased up to about 1/2 ounce per 100 square yards. Seeding rates from 1/2 to 1 ounce per 100 square yards resulted in very small differences in yield of plants suitable for transplanting.
3. The green weights of the tops and roots of the transplants decreased very rapidly as the seeding rate increased from 1/32 to 3/8 ounce per 100 square yards. The decrease was more gradual with increase in seeding rates above 3/8 ounce.
4. Higher seeding rates resulted in only a slight increase in the over-all length of the above-ground portion of the plants; however, the main stems of plants from the more densely seeded beds were definitely longer.
5. Increasing the plant-bed seeding rate from 1/32 to 1 ounce per 100 square yards resulted in a decrease in transplant survival in the field. Blooming date in the field was delayed as plant stand density in the plant bed was increased.
6. Yields and acre values were higher on plots transplanted from plant beds seeded at the lower seeding rates.
7. With burley tobacco, a plant-bed seeding rate of 1/4 ounce per 100 square yards led to the production of a substantial and economical number of desirable transplants that performed well in the field. Seeding rates lower than 1/4 ounce produced stockier but fewer transplants that performed well in the field. These plants were difficult

to transfer to the field with mechanical transplanters. Seeding rates higher than 1/4 ounce did not substantially increase the yield of transplants during the normal transplanting period (2 weeks). As the rate of seeding was increased, transplants became progressively spindlier, more vulnerable to the shock of transplanting, and slower in establishing themselves in the field, and the field tobacco was later in maturing, lower in yield of cured leaf, and lower in acre value.

N.C. Agr. Expt. Sta., N.C. State Col., Raleigh, N.C.

212. Peterson, M. L. RICE--AND RESEARCH. Calif. Agr. 17(8): 2-4. 1963.

The $75,000,000 California rice crop produced in 1962 came from some 323,000 acres of land primarily suited to rice culture on 1,400 farms. Yields averaged 4,800 pounds of dry paddy rice per acre--two or three times the amount per acre in many other areas of the world--despite a mid-harvest October storm that lodged much of the crop and increased harvesting problems and costs. Because rice is our most highly mechanized crop, only 7½ man hours per acre per year were needed to produce these high rice yields in California, as compared with 400 to 900 man hours in other areas of the world.

Rice is not only important to the economy of our State, but it is the basic food for over 60 percent of the world's population, including most of the emerging nations. California's highly efficient, all-mechanized rice industry is a tribute to the excellent cooperation of private industry, growers, and research workers in solving many complex problems.

A summary of rice research in California was given.

U. Calif., Berkeley, Calif.

213. Beasley, E. O., and Dickens, J. W. ENGINEERING RESEARCH IN PEANUT CURING. N.C. Agr. Expt. Sta. Tech. B. 155, 38 pp. 1963.

Freshly-dug Virginia bunch peanuts were cured in 1960-61 with a wide variety of closely-controlled temperature and relative humidity combinations. The amount of shelling damage was measured for each curing treatment, and the effects of drying rate were examined. Some of the samples were deliberately overdried and reconstituted to normal moisture content in order to investigate the extent and permanence of milling quality impairment through overdrying.

An increase in the drying rate of peanuts during the curing operation caused an increase in split and skinned kernels during mechanical shelling. The actual rate of water removal appears to be the overriding factor in this relationship, rather than any physiological changes brought about by elevated temperatures per se.

The moisture content of peanuts had a profound effect on the amount of splitting and skinning which resulted from the shelling operation. Reducing the shelling moisture content from 9 percent to 6 percent increased the total shelling damage 500 to 700 percent in some cases. This excessive shelling damage was avoided to a large degree when the moisture content was restored to 9 percent prior to shelling.

Kernel size as determined by screening was affected by rate of drying with faster drying rates yielding a slightly lower percentage of extra large kernels (ELK) and a correspondingly higher percentage of No. 1 kernels. Moisture loss was definitely accompanied by shrinkage of the kernels, which resulted in few extra large kernels and more No. 1 and

shriveled kernels (OK). This change proceeded in the opposite direction when moisture content was increased.

The apparent density of the kernels tended to be less for the faster drying rates. This fact, coupled with the decrease in kernel size with increased drying rate, seems to indicate either an actual loss of dry matter from the peanut kernel or a change in kernel configuration due to rapid drying.

Every physical quality factor considered was either definitely or tentatively enhanced by a moderate to slow rate of drying, with drying terminated at not less than 9 to 10 percent moisture content. Kernel size is a factor in determining the farmer's price for peanuts, and continues to be important throughout processing and use of the product. Milling quality is important to the sheller, and is also of considerable interest to subsequent processors. Density has not been singled out as a primary quality factor, but higher density peanuts would appear to be preferable to those with lower density. The advantage of increased curing capacity brought about by a more rapid drying rate must be weighed against the reduction in peanut quality which would ensue.

N.C. Agr. Expt. Sta., N.C. State U., Raleigh, N.C.

214. Culp, T. W. CASTORBEAN PRODUCTION IN THE MISSISSIPPI DELTA. Miss. Agr. Expt. Sta. B. 677, 8 pp. 1963.

A "culture and care" publication on castorbean production in the Mississippi Delta was given.

Extremely high yield losses from capsule drop during the period of 1957-62 indicated that this disease must be controlled if castorbeans are to become a commercial crop in the Mississippi Delta and surrounding area. The development of disease-resistant varieties is considered the best method of controlling this disease. Resistant varieties may be available in the near future.

Early harvesting, before capsule drop causes severe yield losses, may be a satisfactory method of controlling this disease and producing this crop. By chemically desiccating and harvesting castorbeans in late September or October, satisfactory yields of over 2000 pounds of seed per acre were obtained in most tests from 1959-62.

Producers should make definite arrangements to harvest and sell the crop before planting castorbeans.

Miss. State U., Agr. Expt. Sta., State College, Miss.

215. Valleau, W. D., Johnson, E. M., and Diachun, S. TOBACCO DISEASES. Ky. Coop. Ext. C. 522A, 68 pp. Rev. 1963.

Tobacco diseases in Kentucky were described and illustrated. Recommended control methods were given.

U. Ky., Coop. Ext. Serv. Agr. and Home Econ., Lexington, Ky.

216. Halisky, P. M. HEAD SMUT OF SORGHUM, SUDANGRASS, AND CORN, CAUSED BY SPHACELOTHECA REILIANA (KÜHN) CLINT. Hilgardia 34(8): 287-303. 1963.

The recent increase of head smut in the grain-sorghum areas of the Midwest, Texas, and California coincided with the introduction of highly susceptible sorghum hybrids. The disease is difficult to control because: It is transmitted by soil-borne spores; the infection persists in volunteer host plants; and several of the susceptible hybrids outyield any resistant variety available at present.

Sporulation of Sphacelotheca reiliana in a susceptible host occurs typically in the inflorescence, which is transformed into a sorus. Foliar sori also are found in certain varieties of sudangrass and field corn but rarely in grain sorghum. The infection is systemic and may induce floret sterility and certain growth aberrations, such as bizarre proliferations of the inflorescence. Dwarfing of hosts is common; the amount of dwarfing was determined by measurements in fields of mature Ryer 15 sorghum and King Philip maize. Moisture stress favors infection of sorghum.

Pathogenic specialization occurs in S reiliana, with one race group limited to corn and the other pathogenic not only to grain sorghums but also to sorgos, forage-sorghum hybrids, sudangrass varieties, and some sweet-corn varieties. Lahoma sudangrass was found immune to head smut, and four other sudangrass varieties were resistant.

Experiments have shown that: Infection originates primarily from soil-borne smut spores; the incidence of infection is proportional to the amount of inoculum built up in a soil, as by continuous cropping to sorghum; and soil temperatures between 21° and 28° C. favor the infection in corn. Experimental infection of Johnsongrass was not successful.

Agr. Pub., University Hall, U. Calif., Berkeley 4, Calif.

217. Foy, C. L. THE INFLUENCE OF FORMULATION, EXPOSURE TIME, AND pH ON THE HERBICIDAL ACTION OF DALAPON FOLIAR SPRAYS TESTED ON CORN. Hilgardia 35(7): 125-144. 1963.

Technical and commercial dalapon were tested on corn, with or without one of the surfactants: Vatsol OT, Dynawet, and X-77. Acid dalapon and four of its salts were also tested.

In greenhouse and laboratory investigations, a small amount of dalapon was absorbed by corn leaves almost instantly, when a suitable surfactant was included in the spray. If no acute toxic action resulted, absorption and translocation continued for several days, although spray droplets appeared to dry within minutes. The wetting agent in the commercial dalapon formulation greatly enhanced penetration, and the advantage of using various additional surfactants was demonstrated: On the basis of growth inhibition, it appeared that corn absorbed as much dalapon in one hour from sprays containing surfactant as in two weeks from a solution without surfactant. In general, except for Vatsol OT, increasing rates of nontoxic surfactants continued to increase herbicidal activity.

The acid and the sodium salt of dalapon were about equal in effectiveness. Both inhibited growth more than did the potassium, ammonium, or calcium salt. Some interesting interactions between formulations and surfactants were disclosed. For example, Vatsol OT, an excellent surfactant with the sodium salt of dalapon, was completely ineffective with the calcium salt.

Dalapon penetrated corn leaves most readily in the nondissociated form, or at low pH in aqueous solutions. When growth inhibition--which depends on effective translocation--was used as the criterion, acute toxicity at very low pH created an opposing trend. Optimum herbicidal results were obtained at about pH 6, near the pH of a solution of commercial dalapon sodium salt in tap water.

The toxicity to corn of various dalapon formulations was discussed and interpreted in relation to known physicochemical properties of the parent compound, 2,2-dichloropropionic acid.

Agr. Pub., University Hall, U. Calif., Berkeley 4, Calif.

218. Rosanow, M. WEED CONTROL IN SUGAR BEET BY NITRATE OF SODA SPRAYS. Zemljiste I Biljka 11(1-3): 377-382. 1962.

A method of post-emergence control of weeds in sugar beet by means of Chilean nitrate of soda sprays was described. Although not all the weeds were susceptible for this spray, sufficient control was obtained provided that weather conditions were favorable and care was taken to follow the given directions. The method should not be considered as a substitute for good cultural practices, but as a means to facilitate the maintenance and thinning of the young crop.

The best results were obtained with 300 to 350 kg. (661.4-1102.3 lb.) of nitrate of soda dissolved to give a final volume of 800 to 1000 l. (0.843-1.057 qt.) of spraying solution per ha. (2.471A.) Addition of a wetting agent was indispensable for a good effect. Spraying was carried out during dry weather at a temperature of about 15^{o} C. when the beets were forming the first true leaves.

This method was cheap because the nitrogen of the spray became fully available to the beet crop in time to perform its fertilizing action.

Plant Nutr. Res. Lab., Chilean Nitrate Agr. Serv., Wageningen, Netherlands.

219. Grant, W. R., and Mullins, T. ENTERPRISE COSTS AND RETURNS ON RICE FARMS IN THE NORTHEAST ARKANSAS RICE AREA. Ark. Agr. Expt. Sta. Rpt. Ser. 125, 65 pp. 1963.

During recent years, several factors have caused major changes in the use of resources on rice farms. Increased supplies of rice during the early 1950's resulted in a return of rice acreage allotments in 1955. The resultant decrease in the acreage of rice released considerable land, irrigation facilities, farm equipment, labor, and capital for other uses. In addition, advances in technology have brought about improvements in production methods. Yields have been increased by the use of new varieties, heavier rates of fertilization, and the development of effective chemicals for combating pests such as weeds and insects. These rapid technical changes make it advisable for rice producers continuously to reevaluate their enterprise organization and production methods. The budgets in this report were developed to show the annual labor, power, and machinery requirements, monthly labor distribution, and costs and returns for rice, soybeans, oats, wheat, corn, and cotton.

771-426 O-65—8

Table.--Summary of Costs and Returns per Acre by Crop, Farm Size, and Level of Technology[1]

Crop and farm size	Present technology				Advanced technology			
	Gross returns	Specified expenses	Labor	Net returns[2]	Gross returns	Specified expenses	Labor	Net returns[2]
	Dollars per acre							
Rice								
Small farm	184.50	66.12	13.13	105.25	258.75	82.89	14.06	161.80
Med. and large farms	184.50	68.20	13.13	103.17	258.75	85.41	14.06	159.28
Soybeans, 0 to 1 percent slope, non-irrigated								
Small farm	56.40	23.40	5.40	27.60	72.85	25.96	5.15	41.74
Med. and large farms	56.40	25.18	5.40	25.82	72.85	27.86	5.15	39.84
Soybeans, 0 to 1 percent slope, irrigated								
Small farm	70.50	28.29	7.69	34.52	86.95	31.83	7.94	47.18
Med. and large farms	70.50	30.26	7.69	32.55	86.95	33.98	7.94	45.03
Soybeans, over 1 percent slope, non-irrigated								
Small farm	47.00	22.85	5.22	18.93	63.45	25.57	5.06	32.82
Med. and large farms	47.00	24.48	5.22	17.30	63.45	27.37	5.06	31.02
Oats, 0 to 1 percent slope								
Small farm	31.50	28.11	3.84	-0.45	49.00	35.89	4.25	8.86
Med. and large farms	31.50	29.81	3.84	-2.15	49.00	37.96	4.25	6.79
Oats, over 1 percent slope								
Small farm	35.00	28.50	3.94	2.56	52.50	36.21	4.31	11.98
Med. and large farms	35.00	30.40	3.94	0.66	52.50	38.45	4.31	9.74
Wheat, 0 to 1 percent slope								
Small farm	54.00	28.67	3.84	21.49	72.00	35.81	4.16	32.03
Med. and large farms	54.00	30.37	3.84	19.79	72.00	37.80	4.16	30.04
Wheat, over 1 percent slope								
Small farm	59.40	29.00	3.94	26.46	81.00	36.68	4.45	39.87
Med. and large farms	59.40	30.90	3.94	24.56	81.00	39.04	4.45	37.51
Corn, 0 to 1 percent slope								
Small farm	39.90	29.33	8.99	1.58	91.20	40.29	7.05	43.86
Med. and large farms	39.90	27.46	9.95	2.49	91.20	39.37	8.08	43.75
Corn, over 1 percent slope								
Small farm	30.78	28.97	8.69	-6.88	79.80	39.84	6.71	33.25
Med. and large farms	30.78	27.04	9.65	-5.91	79.80	38.84	7.74	33.22
Cotton, 0 to 1 percent slope, non-irrigated								
Small farm	146.28	56.20	57.25	32.83	238.02	81.49	76.79	79.74
Med. and large farms	129.50	74.28	22.52	32.70	210.70	103.37	17.44	89.89
Cotton, 0 to 1 percent slope, irrigated								
Small farm	201.24	70.28	76.48	54.48	292.98	95.82	97.31	99.85
Med. and large farms	178.22	89.72	26.31	62.19	259.00	121.27	24.10	113.63
Cotton, over 1 percent slope, non-irrigated								
Small farm	124.38	53.96	51.37	19.05	197.52	77.16	64.80	55.56
Med. and large farms	110.22	70.31	20.92	18.99	174.76	96.61	15.59	62.56

[1] For an explanation of differences in costs, see text under "Resources."

[2] Returns to land and management.

Tables.

Agr. Expt. Sta., U. Ark., Fayetteville, Ark.

SEE ALSO 24, 27, 48, 53, 71, 87, 90, 103, 115.

220. Gavett, E. E. TRUCK CROP PRODUCTION PRACTICES * LABOR, POWER, AND MATERIALS, BY OPERATION. U.S. Dept. Agr., Econ. Res. Serv. **

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CAMERON AND HIDALGO COUNTIES, TEXAS	ERS-115, 76 pp. 1963
IMPERIAL COUNTY, CALIFORNIA	ERS-128, 42 pp. 1963
MONTEREY COUNTY, CALIFORNIA	ERS-129, 41 pp. 1963

These three publications contain information on labor requirements, production practices, and costs involved in the production of truck crops for fresh market and processing for the area indicated.

Tables and charts.

OMS, USDA, Inform. Div., Washington, D.C., 20250

221. James, S. C. PRODUCTION AND MARKETING CONSIDERATIONS FOR NEW MEXICO VEGETABLES AND RELATED FIELD CROPS. N. Mex. Agr. Expt. Sta. B. 482, 50 pp. 1963.

Annual gross farm receipts from vegetables averaged over six million dollars between 1957-61 in New Mexico. Dry field beans and peanuts grossed an average of over two million dollars in this same period.

The average acreages and yields of the crops included were presented in a summary table, along with an indication of the importance of each crop to the national production.

The average acreages planted to lettuce, onions, and irish potatoes were increased, and those planted to cantaloupes, carrots, dry beans, and peanuts were decreased between 1947-51 and 1957-61. Acreage in chile remained nearly constant. Data were available only within recent years for sweetpotatoes and tomatoes.

Over the past 15 years, yields per acre in New Mexico increased for most vegetable and field crops. However, cantaloupe and carrot yields decreased. Yields were generally higher in New Mexico than in competing states for spring and fall lettuce, sweetpotatoes, peanuts, and dry onions except in California where the yield gap has been narrowing. Yields of cantaloupes, carrots, Irish potatoes, and fresh market tomatoes competed less favorably. Processing tomato yields were above those in Texas and Colorado but below the United States average.

Incomes from vegetable farming vary widely. Standard deviations and variability coefficients were determined for each crop except chile. These were presented in summary table, where crops were ranked by variability coefficients for gross income per acre. The expected variation in yearly income from a crop may be a determining factor in crop selection.

A major cause of price fluctuations was farmers' response to price. New Mexico farmers usually responded to favorable prices with larger plantings the next year, and vice versa. Price was positively correlated with the following year's planted acreage in most of the 15 years.

Agr. Expt. Sta., N. Mex. State U., University Park, N. Mex.

222. Nour, M. ONIONS FOR THE MIDDLE RIO GRANDE VALLEY--VARIETIES AND PLANTING DATES. N. Mex. Agr. Expt. Sta., Res. Rpt. 84, 8 pp. 1964.

Different varieties of onions were planted at weekly intervals in September, October, February, March, and April to determine the best time to plant any given variety for maximum production under the climatic conditions of the Middle Rio Grande Valley in New Mexico.

The highest yield of marketable Grano bulbs was obtained when seed was planted the first week in September.

The highest yields of marketable Spanish bulbs were obtained when seed was planted in the last 2 weeks in February and the first 2 weeks in March.

Spanish varieties planted early in the fall frequently bolted.

Texas Yellow Grano, White Grano, and White Granex were high yielders for early fall plantings, and did not bolt.

Yellow Sweet Spanish was the highest yielder for late fall and spring plantings.

Grano varieties were earlier in maturity than Spanish varieties by about four weeks, when they were planted at the same time.

Agr. Expt. Sta., N. Mex. State U., University Park, N. Mex.

223. AULTMAN, D. A., and Windham, S. L. HEAD LETTUCE PRODUCTION. Miss. Agr. Expt. Sta. B. 676, 8 pp. 1963.

Copiah County, Miss., has a total of 2035 farms of which 1055 are less than 80 acres in size. These conditions are also present in several other counties in the State. Diversification is absolutely essential for these farms. Lettuce will fit into such a program. It grows at a time of the year when very few other row crops are grown and harvested.

Tests at the Truck Crops Branch Experiment Station showed that lettuce can be grown successfully during late winter and early spring. Lettuce grown on the Station and in the surrounding area has been well received by the local market. This crop provides an opportunity for the truck and market gardener to supply his local community with high quality lettuce during April.

Recommendations for successful production of head lettuce in Mississippi were given.

Miss. State U., Agr. Expt. Sta., State College, Miss.

224. Peirce, L. C., Vance, B. F., Fogleman, M. E., Worf, G. L., and Gunderson, H. TOMATOES. . .HOW TO GROW THEM FOR HOME AND MARKET. Iowa Coop. Expt. Serv. Pamphlet 299, 12 pp. 1963.

The tomato is one of the most popular vegetables in the United States. The number of tomato products and recipes for their use testifies to the importance of this vegetable in the diets of Americans. As a commercial crop, it ranks as one of the most important in farm value. In the home garden, it is unsurpassed in popularity.

With this popularity, and the intensity of production, many questions arise about growing tomatoes, varieties to plant, controlling pests, and harvesting the fruit. This publication is divided into the following four parts: Crop--its climatic and soil requirements; seed--varieties, seed treatment, and methods of seeding; plant--transplanting, fertilization, spacing, pest control, and special techniques; fruit--harvest and storage.

Iowa State U. Sci. and Tech., Coop. Ext. Serv., Ames, Iowa.

225. Poole, W. D. HARVESTING SWEET POTATOES IN LOUISIANA. La. Agr. Expt. Sta. B. 568, 24 pp. 1963.

Mechanical handling and harvesting of sweet potatoes offer the best possible solution for reducing the cost of production of sweet potatoes, which is the most important vegetable crop in the South and the second most important vegetable crop in the United States.

Farmers with small acreages of sweet potatoes have not been able to mechanize because of the high cost involved. Therefore, the trend has been to concentrate sweet potato production into larger farm units which can justify mechanization. Larger acreage per farm unit justifies the use of power equipment such as tractor plows, transplanters, tractor cultivators, and mechanical harvesters.

With the exception of mechanical harvesters, much of the machinery developed for other crops could be adapted to sweet potato culture. Since harvesting requires more man-hours of labor than all other operations combined, development design and research have been directed toward a suitable machine for harvesting sweet potatoes.

The various machines that can be used for harvesting sweet potatoes were described and illustrated.

La. State U. Agr. and Mech. Col., Agr. Expt. Sta., Baton Rouge, La.

226. Sparks, W. C., McMaster, G., Dixon, J. E., Works, D. W., and Wilson, E. B. IDAHO POTATO STORAGES CONSTRUCTION AND MANAGEMENT. Idaho Agr. Expt. Sta. B. 410, 31 pp. 1963.

The necessity of maintaining high-quality, sprout-free potatoes over an extended storage period for the fresh market and the processing industry, has resulted in an increased emphasis on the proper construction and management of potato storage facilities. With increased emphasis on maintaining high quality and appearance over a longer storage period, improved temperature and humidity control are necessary. Well designed track-side and farm storages, with automatic air ventilation and temperature control systems, are becoming a necessity and are replacing the older types.

Potatoes are stored to: (1) Maintain the tubers in the most edible and salable condition during the winter, spring, and early summer months; (2) provide a uniform supply to the fresh market and processing industry; (3) keep seed potatoes in good condition; and (4) maintain high processing qualities throughout the entire storage season.

A potato storage properly constructed and managed helps to: (1) Prevent the development of rot; (2) retard growth of sprouts; (3) reduce dehydration and excessive moisture loss; and (4) reduce the number of pressure bruises and black spot.

Many types and sizes of structures are used to store potatoes. Each has its advantages and disadvantages. Choice of the type depends upon: cost; available material; convenience; space requirements inside the cellar; and local conditions such as water table, rock and soil structure, and sub-soil winter temperatures.

Most structures used for storing potatoes in Idaho can be classified into the following types: (1) The partially below-ground, pole-type structure; and (2) the above-ground, wood or steel frame building.

Types of structures were described and illustrated. Recommended methods for storage management of potatoes were given.

U. Idaho, Col. Agr., Idaho Agr. Expt. Sta., Moscow, Idaho.

Costs and Returns

SEE ALSO 14, 28, 102, 104, 105, 132, 163, 178, 181, 182, 192, 219, 220, 221, 271, 293.

227. Rixe, L. C., and Jensen, H. R. COST ADVANTAGES TO SIZE OF FARM IN RED RIVER VALLEY FARMING. Minn. Agr. Expt. Sta., Sta. B. 469, 16 pp. 1963.

Both the analyses of per acre costs and costs per $100 gross income led to the conclusion that there were cost advantages as farm size increased. These cost advantages were apparent for all three groups of farms studied (Cash grain farms, cash grain farms with sugar beets, and cash crop farms with some livestock).

The cost advantages or economies were large when moving from one farm size level to another within the smaller size range. Most cost economies were realized when farms reached a $40,000 gross income size. This income level corresponds to a farm of about 1,100 crop acres in the cash grain group and to 700 crop acres in the cash grain plus sugar beet group.

When per unit costs decreased as size increased, an incentive exists (particularly for above average managers) to increase the size of business. The upward pressure on farm size is likely to continue as many farmers seek to improve their income positions through the lower unit costs and larger gross incomes associated with increasing size. This upward pressure was also suggested by many farm operators. Approximately 70 percent of all farmers interviewed indicated they could handle more land with their present power, labor, and machinery. More than 70 percent believed it would be profitable for them to handle more land.

The strong pressure for more land to add to existing farming units tends to hold land prices at relatively high levels. As a consequence, some farm owners will be encouraged to sell while others may hold off in anticipation of higher future land prices. If many hold off and land prices increase, unit costs will increase. Then the profitability of adding land to an existing unit may no longer be clearly evident.

Farms in the study area are likely to grow larger and to decrease in numbers for some years to come. In considering enlarging their farming units, farmers may want to evaluate carefully the alternatives available. Alternatives include: (1) Adding land through purchase; (2) adding land through renting; and (3) adding more capital and labor to existing land. One alternative may be best in one farm situation while another may be best in a different situation. The choice of any one or of a combination of these alternatives means handling more resources. This is likely to require more management.

U. Minn., Agr. Expt. Sta., St. Paul, Minn.

228. Atkins, S. W. ECONOMIC APPRAISAL OF CONSERVATION FARMING IN THE GRENADA-LORING-MEMPHIS SOIL AREA OF WEST TENNESSEE. Tenn. Agr. Expt. Sta. B. 369, 47 pp. 1963.

The effects of different levels of soil conservation on crop yields, farm costs, and net farm income over time was appraised for upland farms in the Grenada-Loring-Memphis Soil Area of West Tennessee.

Three levels of conservation were analyzed: (1) Low level, consisting of continuous row cropping with contour cultivation but no winter cover crops; (2) moderate level, consisting

of continuous row cropping with parallel strip cropping and no winter cover; and (3) high level, consisting of continuous row cropping, parallel terracing and winter cover crops on cotton land. A fourth level, consisting of continuous sod, was not included in the economic appraisal because of negligible soil losses and relatively constant rates of production over time.

Annual soil losses and crop yields over time were estimated for the different levels of conservation on the various soils occurring on the farm. Using these yield estimates and other input-output data, net labor incomes were computed for a grade C dairy-hog-cotton system by 25-year periods over the productive life of the soil.

These income estimates were based on the assumption that type of farming, production technology, and prices of farm products and items used in production would not change over the period of the study. Thus, the changes in net income would be the result of changes in rates of crop production resulting from soil change.

Soil losses, according to these estimates, would be insignificantly larger on soils managed under the low conservation system than under high conservation. The most productive or most desirable part of Loring soil, for example, would be lost in 200 years under low conservation and 940 years under high conservation. Consequently, crop yields under high conservation were estimated to decline at a relatively slow rate.

In the early years, net incomes under high conservation would be reduced below incomes obtained under low conservation. Net labor returns under high conservation on the case-study dairy-hog-cotton farm would be 10 percent less than net returns under low conservation in the bench mark period.

If all costs (cash and noncash) are charged and future incomes are discounted at 6 percent per year, high conservation would not be profitable during the lifetime of present farmers under the assumptions of constant technology and constant prices. The sum of all present values of future incomes from high conservation would be 10 percent below similar incomes from low conservation for the first 50 years. For moderate conservation, the comparative income would be only 3 percent below that for the low conservation level of management. Omission of noncash costs, however, would improve the relative income position of the higher conservation systems.

U. Tenn., Agr. Expt. Sta., Knoxville, Tenn.

229. Andersen, J. C., Heady, E. O., and Shrader, W. D. PROFIT-MAXIMIZING PLANS FOR SOIL-CONSERVING FARMING IN THE SPRING VALLEY CREEK WATERSHED IN SOUTHWEST IOWA. Iowa Agr. and Home Econ. Expt. Sta. Res. B. 519: 943-964. 1963.

Whether farmers in the Spring Valley Creek Watershed in Mills County, Iowa, can profitably conserve their soil to an increased extent was determined. These farmers presently fall far short of conservation goals of public agencies. Although the conservation goals are stated in terms of preventing loss of topsoil, closely related problems of gullying, flooding and channel siltation are important.

Alternative water-control measures in a particular watershed were studied. In the watershed studied, no concerted action has been taken by the group of farmers to organize under Public Law 566. The questions toward which this research was directed were: Can farmers in the Spring Valley Creek Watershed in southwest Iowa, where soil is easily eroded, profitably adjust their farming operations to conserve their soil at recommended levels? Or, does a lack of possibility to improve farm income under conservation farming methods require participation in, and subsidy from, public watershed programs?

The present farming organization of 28 farmers of Spring Valley Creek Watershed was compared with plans devised by linear programming for maximum income obtainable from the resources of the farms subject to rigid soil-erosion restrictions.

The comparisons between the present and optimum soil-conserving plans provide the following generalizations:

1. Net profit could be increased by an estimated $1,744 per farm by changing from present farming systems to economically planned soil-conserving systems of farming.
2. Increased use of capital would give high returns on most farms. It was estimated that added capital would return up to 50 percent on investments on some farms.
3. Row cropping can be increased on farms of the watershed, and the Soil Conservation Service goals for diminishing soil loss can still be attained. Row crops are presently grown on 48 percent of the cropland, but the optimum soil-conserving plans allow 71 percent of the cropland to be in row crops.
4. Fertilizer was estimated to be used at only about 15 percent of the optimum level. Optimum plans include a higher rate of fertilizer application than currently used on all of the farms programmed.
5. Livestock production should be more specialized than at present. Fewer forage-consuming and more grain-consuming types of livestock were in the optimum plans of most farms.

A soil-conserving farming system could be profitably adopted on all farms of the Spring Valley Creek Watershed. Since soil erosion, flooding, and gully development are all caused by excessive water movement, treatment for one of these conditions has concurrent advantageous effects on the others. It was estimated that control of soil erosion in Spring Valley Creek Watershed by the methods given would be effective in attaining watershed goals and that additional public subsidies would not be required.

Many farmers do not now believe that conservation practices can be integrated into a profitable farm organization. Wider acceptance of conservation farming can be gained by showing farmers the advantages of farm plans that consider the unique set of problems of each farm. Capital, type, and amount of land, buildings, labor, farmer ability, and preferences must all be integrated into ideal conservation plans. Better attainment of conservation goals on individual farms would then free the limited public funds allocated to conservation activities to be used in critical areas where private action is not feasible.

Agr. and Home Econ. Expt. Sta., Iowa State U. Sci. and Tech., Ames, Iowa.

230. Lanham, W. J. RESOURCES REQUIRED FOR SPECIFIED LEVELS OF INCOME ON COTTON FARMS, UPPER COASTAL PLAIN, SOUTH CAROLINA. S.C. Agr. Expt. Sta. AE 242, 29 pp. 1963.

Information on the combination and quantity of resources needed to obtain specified levels of income on cotton type farms in the Upper Coastal Plain area of South Carolina was given. The estimates serve to indicate the farm organization likely if the assumed restrictive conditions imposed are fulfilled.

Within the study assumptions, which include the present (1962) level of cotton allotment for cotton type farms in the area, and the use of advanced production technology, the quantity of resources which minimized total cost and achieved, the income goal was determined. Four levels of returns to the farm operator's labor and management were considered--$2,500, $3,500, $4,500, and $5,500.

The programmed farm organizations included cotton, soybean, and loblolly pine production activities for all specified income level situations. Farm size was larger than the 97-acre average size commercial cotton farm of 1959. Increases in total land requirements above the 1959 level ranged from 43 percent for the $2,500 income level situation to 148

percent for the $5,500 situation. The range of total investment for the specified income level situations was from $28,000 to $50,800. Land investment comprised about three-fourths of the total investment.

High land prices would be an obstacle for individuals desiring to enter farming or to expand the size of their present farm. However, it was possible for those farm operators who already own or have an equity in farms comparable in size to the programmed farm organizations to realize additional net income from their land investment. This study gave consideration only to returns to the operator's labor and management.

The use of advanced production technology, including mechanized harvesting of cotton, served to hold labor requirements per farm unit at levels sufficiently low that the operator and a small amount of family or seasonal hired labor performed all farm jobs. Some farm operators, after viewing alternatives for their labor, may decide to hire or use family labor for most of the farm labor needs. Under these circumstances the operator may become engaged in off-farm work and limit his farming activities to supervisory functions. Such an arrangement may result in a higher net income for the family unit than could be realized from farm sources alone.

S.C. State Expt. Sta., Clemson Col., Clemson, S.C.

231. Davis, J. H., Sonnier, E. A., and White, T. W. PASTURE-RICE ROTATIONS FOR SOUTH-WEST LOUISIANA. La. Agr. 7(1): 4-5. 1963.

There are approximately 1,500,000 acres of land in southwest Louisiana on which rice is grown. Acreage controls, market demands, and other factors, however, permit the planting of only about 500,000 acres of rice each year.

The production of beef from pasture seems to be one of the most suitable uses for land not in rice. There is a minimum amount of competition between these two enterprises for farm resources such as labor, land, buildings, and machinery.

The customary rotational system used on rice-beef cattle farms is 1 year rice followed by 1 or more years of pasturing the rice stubble and wild grasses which occur.

An experiment to determine the optimum length of time for pasture-rice rotations was initiated at the LSU Rice Experiment Station in 1953. The results are shown in the following tables.

TABLE 1.--Performance of Various Pasture-Rice Rotations, 10-Year Average, 1953-1962

Type rotation	Pounds per acre			
	Rice	Beef in pasture years	Beef in rice years	Beef for each acre in system
1 year native pasture 1 year rice	2988	40	10	25
1 year improved pasture 1 year rice	2820	220	87	154
2 years improved pasture 1 year rice	3180	227	63	172
3 years improved pasture 2 years rice	3082	258	25	165
4 years improved pasture 2 years rice	2957	221	42	161

TABLE 2.--Average Days Grazing per Acre from Various Pasture-Rice Rotations

Type rotation	Rice years	Pasture years	Average for each acre in system
1 year rice 1 year native pasture	22	146	84
1 year rice 1 year improved pasture	89	264	177
1 year rice 2 years improved pasture	92	221	178
2 years rice 3 years improved pasture	60	251	175
2 years rice 4 years improved pasture	51	207	155

TABLE 3.--Costs and Returns per Year from Each Acre in Various Pasture-Rice Rotations

Type rotation	Gross per acre from rice[1]	Gross per acre from pasture[2]	Total gross return per acre	Added cost for pasture seed and fertilizer	Returns over cost of pasture seed and fertilizer
1 year rice 1 year native pasture	$75	$ 5	$ 80	$ 0.	$80.
1 year rice 1 year improved pasture	71	31	102	10.	92.
1 year rice 2 years improved pasture	53	35	88	8.	80.
2 years rice 3 years improved pasture	62	33	95	7.	90.
2 years rice 4 years improved pasture	49	32	81	7.	74.

[1] Value of rice calculated at 5 cents per pound.
[2] Beef produced valued at 20 cents per pound.

Rice Expt. Sta., Crowley, La.

232. Hamill, J. G. COST AND RETURNS TO PRODUCERS OF MILK FOR MANUFACTURING: AS AFFECTED BY VOLUME OF PRODUCTION, MANAGEMENT, AND PRICE. Miss. Agr. Expt. Sta. B. 672, 20 pp. 1963.

The sharp decline in the supply of milk for manufacturing has caused much concern within the industry. Increases in the volume of "Grade A" surplus milk have failed to offset the decline in volume supplied by producers of manufacturing milk. Some of the more

important factors leading to the decline in production by producers of manufacturing milk have been: (1) Increased production costs; (2) high beef cattle prices; (3) the low price of milk for manufacturing relative to the price of "Grade A" milk; and (4) retirement of the acceptance of off-farm employment by dairy farmers.

Present management practices and enterprise combinations on manufacturing milk farms yield low returns. Even before allowing for interest on investment, the typical farm in two of the five size-groups studied showed returns of $800 or less in 1958. Average earning of capital, labor, and management for the remaining size-groups ranged from $1,450 to $2,200.

Linear programming techniques were used to evaluate the effect of milk prices, improved management practices, and resource availability upon farm organization and income. At 1958 prices, optimum farm organization with improved management practices would have increased returns to the factors of production by as much as 120 to 440 percent.

To achieve returns to capital, labor, and management of $2,000, $4,000, and $6,000, it would be necessary to have an investment of $27,000, $51,000, and $84,000 if the 1958 milk price decreased by 10 percent (from $3.39 to $3.05 per cwt.). If the 1958 milk price increased by 10 percent (from $3.39 to $3.73 per cwt.), an investment of $21,000, $35,000, and $51,000 would be required to achieve the specified returns to capital, labor, and management. With a 20 percent increase in the 1958 milk price (from $3.39 to $4.07 per cwt.), an investment of $19,000, $31,000, and $43,000 would be necessary to achieve the specified income levels. With the highest price and income level, an investment of $43,000 would be required to yield a return of $4,194 per year to labor and management.

Incomes higher than those presently received can be attained through better management, more efficient use of labor and land, and additional capital expenditures. The individual must compare his present or expected returns with alternative enterprises and alternative employment opportunities.

Miss. State U., Agr. Expt. Sta., State College, Miss.

233. Kadlec, J. E., Keller, L. H., and House, A. K. FACTORS AFFECTING COST OF PRODUCING GRADE A MILK IN THE LOUISVILLE MILKSHED. Ind. Agr. Expt. Sta. Res. B. 767, 12 pp. 1963.

The cost per hundredweight of Grade A milk production in the Louisville milkshed varied from $2.50 to $12.00 per hundred weight on a sample of 203 farms in 1957. The major causes of this cost variation were identified.

Differences in the amount of milk produced from given resources as measured by production per cow and a technical efficiency index was closely related to cost per hundredweight of milk produced. As much as $2.30 difference in cost per hundredweight of milk existed from the high 10 percent to the low 10 percent of production per cow and technical efficiency. Farmers who were able to obtain more output with the same quantity of resources but superior practices and resource quality had a much lower cost.

The relationship between size and cost per hundredweight of milk was estimated for three levels of management--high, average, and low. As size increased from 10 to 40 cows the cost per hundredweight of milk decreased by $1.50 to $3.00 depending on the level of management. The cost decrease with increased size was greater for average and below average managers than for above average managers.

The minimum cost per hundredweight of milk was near 40 cows for all 3 management levels. The least efficient managers would not be able to cover all costs at any herd size,

the average managers could cover all costs at about 45 cows only, but the most efficient managers would make the most profit with more than 70 cows.

Producers who were able to keep hours of labor and building investment per cow low had lower production costs.

Purdue U., Agr. Expt. Sta., Lafayette, Ind.

234. Bird, A. R. LEAST COST ORGANIZATION OF MASSACHUSETTS DAIRY FARMS FOR FOUR LEVELS OF GROSS INCOME. Mass. Agr. Expt. Sta. P. 539, 29 pp. 1963.

An electronic computer was used to budget the long-term least-cost organization of Massachusetts dairy farms for four levels of gross income.

For annual levels of milk production of 2,400 hundredweight, 2,880 hundredweight, 3,360 hundredweight, and 3,840 hundredweight, the estimated respective long-term annual operator earnings were $2,500, $3,500, $4,500, and $5,500. "Operator earnings" is the cash return to the farmer for his labor and management after deducting from gross sales the annual expenses associated with the business. These expenses do not include the cost of the farmhouse or allow for any repayment of borrowed capital. However, a capital charge of 5 percent on total investment was included as an expense.

The minimum-cost farm organization for an annual milk production of 2,400 hundredweight comprised a 20-cow farm with 67 acres of land, half of which was cropland and rotation pasture. As with the other three farms, it was essentially a one-man operation. Some 324 hours of extra labor were hired, mainly family labor. Operator earnings per dollar of gross sales were 19 cents.

For the annual milk production of 2,880 hundredweight, a 24-cow farm was required with 80 acres of similar land. Operator earnings per dollar of gross sales were 22 cents.

For an annual milk production of 3,360 hundredweight, a 28-cow farm was required with 93 acreas of similar land. Operator earnings per dollar of gross sales were 25 cents.

For an annual milk production of 3,840 hundredweight, a 32-cow farm was required with 106 acres of similar land. Operator earnings per dollar of gross sales were 26 cents.

All budgets used expected long-term pricing conditions; for example, $5 per hundredweight at the farm gate for milk. They also rely on levels of technology that a reasonably competent manager can expect to attain. For example, the average production per cow was 12,000 pounds of 3.8 percent milk per year.

The rather austere levels of expected operator earnings for the favorable long-term conditions represented by the budgets illustrate the wisdom of the recent trend toward 40- to 60-cow herds in Massachusetts. They also emphasize the need for an economic climate that encourages would-be commercial farmers to attain herd sizes of at least 32 cows, even with the use of superior levels of technology.

Tables.

Agr. Expt. Sta., Col. Agr., U. Mass., Amherst, Mass.

235. Purvis, G., O'Connell, P., Snyder, W. E., and McKellar, E. K. COST ANALYSIS OF DAIRY FARMING IN COLORADO. Colo. Agr. Expt. Sta. Tech. B. 75, 31 pp. 1963.

Cost of milk production in Colorado was studied by examination of individual costs reported by 160 Colorado fluid milk producers for the calendar year 1959. Cost of production data was also collected by mailed questionnaires, and by personal calls on individual producers.

The average farm had 44 cows, a capital investment of $60,627, average capital investment per cow of $1,362, a total cost of production of $4.71 per hundredweight, and an average return for operator management of $1,071.

The individual milk producer and his management ability was the key to a successful milk producing operation. His decisions regarding selection and culling of cows for production, feeding level, labor expenditure, investment in equipment, and regulation of the size of the herd each had a bearing on the overall efficiency of the milk producing operation.

Milk production per cow was an important factor influencing efficiency of milk production. Average milk production per cow per year increased as herd size increased from 8,311 pounds for the 0-20 herd size group to 10,695 pounds for the over 100 herd size group.

High feeding level, as measured relative to Morrison's Standard, was associated with low cost milk production. Regression analysis indicated that within limits of the reported feeding levels, the milk producers with the least total cost per hundredweight fed at levels as high as 178 percent of Morrison's Standard.

Labor efficiency, measured as labor cost per hundredweight of milk, was influenced by size of the herd to a great extent. Labor cost per hundredweight of milk for herds averaging 16 cows, was almost 3 times that of herds averaging 168 cows. Labor cost per hundredweight of milk was relatively stable for herds exceeding 70 cows.

Investment in facilities and livestock for milk production was important in that maximum return on investment for operator management was dependent on a high degree of utilization of facilities. Producers with herds larger than 47 cows realized substantial return for operator management, indicating efficient use of facilities.

Total cost of producing milk decreased as herd size increased. The most rapid decrease in cost was from $6.14 to $3.91 per hundredweight of milk with an increase in average size from 16 to 69 cows. Total cost was nearly constant for herds larger than 70 cows.

The market area in which the producer was located was a factor in feed price, and was reflected in feed cost per hundredweight of milk. Total costs, excluding feed, were essentially the same in all market areas for comparable size milk producing operations.

Only 45 percent of the milk producers in this study operated at a profit. In the Denver Market Area, 65 percent of the producers reported costs greater than mean total cost, and 53 percent of the Denver producers had costs greater than the average price. Of the Denver producers reporting total cost above mean total costs, 23 percent had herds larger than 44 cows.

There was a marked difference between individual operations in costs of producing milk and return for operator management, regardless of size or location. The differences emphasize the important role of the operator and his applied management.

Agr. Expt. Sta., Colo. State U., Fort Collins, Colo.

236. Shaudys, E. T., and Cordrey, J. B. MAXIMIZING INCOME BY EXPANDING THE DAIRY ENTERPRISE ON NORTHEASTERN OHIO FARMS. Ohio Agr. Expt. Sta. Res. B. 958, 27 pp. 1963.

Many dairy farmers in northeastern Ohio are confronted with increasing land values and production costs. In order to maintain a satisfactory level of income, many farmers are seeking ways of expanding their farm business operation.

Several possible methods were developed for expanding an existing or modal farm organization. The modal farm situation was selected to be representative of a large number of family owned and operated dairy farms in the northeastern Ohio counties. Two levels of managerial performance and several levels of capital availability were assumed. Existing

farm resources were programmed. A fixed rotation of corn-corn-small grain-meadow-meadow with several methods of handling the forage crops were considered as possible means of producing and feeding nutrients. In addition, the following ways of caring for the dairy cows were considered: (1) Use the existing or an expanded stanchion facility; or (2) abandon the existing stanchion facility and install a herringbone parlor.

General conclusions of the study were: (1) It was more profitable to expand the existing stanchion facility and add cows to the limit of available labor with level one (10,000 pounds of milk per cow) managerial input. (2) With level one management, an intensive system of handling the forage crops (more forage and less grain) was included in the ration. (3) The added income earned by abandoning the stanchion system, installing a herringbone parlor, and adding the maximum number of cows with level one management did not justify the added risk and responsibility. (4) When level two management inputs (12,000 pounds of milk per cow) were assumed, the herringbone facilities and the addition of a sufficient number of cows maximized income. (5) Labor and capital was generally utilized more effectively by harvesting and feeding nutrients in the form of grain, hay, and pasture rather than a silage. And (6) in general, both an increase in herd production and number of cows were needed before the additional capital investment required for a herringbone facility could be justified. Unless the availability of capital was sufficient to utilize the facility and other farm resources at a high level of intensity, it was more profitable to expand within the limits of the existing facilities found on the farm. Even with level two management the rate of return on added capital invested was greater with an expansion of a stanchion facility than for a herringbone system.

Ohio Agr. Expt. Sta., Wooster, Ohio.

237. Shaudys, E. T., and Sitterley, J. H. OPTIMAL UTILIZATION OF THE FORAGE CROPS AND ORGANIZATION OF A FAMILY DAIRY FARM IN THE CORN BELT. Ohio Agr. Sta. Res. B. 943, 21 pp. 1963.

The capital available greatly influences the optimum organization of other resources available on corn-belt dairy farms. The rotation, the ration fed to the dairy herd, the method of harvesting and feeding the meadow crops, and family income varied with the availability of capital.

A corn-belt dairy farm with ample capital was organized in Ohio. With this organization, the available labor was fully employed and a relatively heavy grain, light forage ration was fed. The maximum amount of corn that was permited was produced and a considerable amount was sold. When labor was a limiting factor, dairy cow numbers were reduced in favor of producing cash grain.

When a farm was organized with less capital available, the amount of forage in the ration was increased and corn decreased. The optimum number of cows kept in the dairy herd was affected by the capital available. The maximum number of cows was kept at the $95,000 capital level. When more capital was available, the available labor was not adequate to care for the cows and to use all of the capital that could be invested profitably. Conversely, when less than $95,000 of capital was available, both the size of the farm and cow numbers were reduced. At the lower level of resource availability, the farm was operated at a more intensive level with the production of more forage in the rotation, which was used in the form of silage, hay, and pasture, and less grain was fed per cow than when more capital was available.

When several systems of handling the forage crops were compared, the differences found in farm family income were small. Other organizational differences such as practices

associated with the care, production, and handling of the dairy cows appeared to be more important factors affecting income than the method selected for harvesting, storing, and feeding the forage crops. In general, rotational grazing of pasture and the use of a field hay conditioner and mow-dryer were desirable. The value of the improvement in hay quality from using a field hay conditioner was considerably greater than the added cost.

Supplemental feeding of the dariy herd during the pasture season rather than attempting to provide the needed nutrients from pasture was economically desirable. Some forages and grains were profitably purchased on these farms and were fed to the cows during both the winter and summer seasons. Organizationally, the balance among the labor, capital, and other resources was much more important than the source of feed.

The making, storing, and feeding of silage was investigated. Making high quality hay was a cheaper source of feed nutrients than silage when the capital cost of erecting a silo was considered. On a large, well-financed farm operation, other possible uses of the resources offered greater returns than was possible with silage. When labor was relatively more abundant, a silo was more favorably considered. When a silo was located on the farm, it was filled with corn rather than a meadow crop due to the relative availability of labor at different seasons for harvesting the silage crop.

Ohio Agr. Expt. Sta., Wooster, Ohio.

238. Chapman, H. L. Jr., Kidder, R. W., Haines, C. E., Allen, R. J., Jr., Green, V. E., Jr., and Forsee, W. T., Jr. BEEF CATTLE PRODUCTION ON ORGANIC SOILS OF SOUTH FLORIDA. Fla. Agr. Expt. Sta. B. 662, 53 pp. 1963.

The Everglades area in Florida contains approximately three-fourths of the organic soils in the State. This area of organic soils, approximately 40 miles wide and 100 miles long, is one of the largest continuous areas in the world of this type soil. The soil depth ranges from 5 to 8 feet near Lake Okeechobee to a foot, or less, near the perimeter of the area.

Native vegetation consisted primarily of sawgrass sedge, willow, elder, and custard apple, none of which are compatible with livestock production. During the 1920's, attempts to establish improved pastures were discouraging, primarily due to soil fertility problems and lack of adequate water control. These problems were overcome during the early 1930's and permanent and improved pastures were developed. These were unsuccessful, primarily because of cattle nutrition difficulties. The cattle industry as it is known today has developed since the early 1940's, when methods for correcting certain mineral imbalances for beef cattle were discovered. The development of the cattle industry was further stimulated by more adequate water control.

Much of the virgin soil constantly becoming available for agricultural purposes is suitable for pastures. Peat and muck soils have an excellent potential for forage and livestock production, but there are problems characteristic to the establishment and management of beef cattle operations on these soils. These include water control, soil preparation, pasture fertilization, livestock management, and equipment. A summary of available information to the beef cattleman was given. Emphasis was placed on commercial, rather than purebred cattle, although much of the information is applicable to purebred herds.

Agr. Expt. Sta., U. Fla., Gainsville, Fla.

239. Meade, J. H., Jr., Kidder, R. W., Koger, M., and Crockett, J. R. ENVIRONMENTAL FACTORS AFFECTING WEANING WEIGHTS OF BEEF CATTLE IN THE EVERGLADES. Fla. Agr. Expt. Sta. Tech. B. 663, 11 pp. 1963.

A study was conducted at Belle Glade, Fla. to determine the effect of certain environmental factors on weaning weights of calves. Weaning data were available on 933 calves covering the period from 1950-59. Environmental factors studied were year of birth, age of dam, sex, month or season of birth, and lactation status. Estimates of these factors which might influence 205-day weights were obtained by the least squares procedures. The study included calves of Angus, Brahman, Devon, Brahman-Angus, and Brahman-Devon breeding.

The variability of year effect covered a range of 145 pounds and was a highly significant factor. Bull calves were 11 pounds heavier than steer calves and steer calves 20 pounds heavier than heifers at 205 days of age. Weaning weights were heaviest from cows 6 to 11 years of age. Calves produced from cows younger than 6 and older than 11 years were lighter at weaning.

Month or season of birth showed a significant influence on weaning weight. Calves born in December through June averaged 7 pounds heavier than November calves and 18 pounds heavier than calves born in July through October. Lactation status of dam had no significant effect on 205-day weaning weight.

The results indicate that factors other than breeding have a significant influence on weaning weights. Beef cattle producers should become aware of these environmental factors and their effect on the production of their cattle.

Agr. Expt. Sta., U. Fla., Gainesville, Fla.

240. Keith, T. B., Dahmen, J. J., Orme, L. E., and Bell, T. D. STEER FEEDING--BARLEY IN NON-ROUGHAGE RATIONS. Idaho Agr. Expt. Sta. B. 412, 19 pp. 1963.

Three series of studies were made in Idaho to evaluate: (1) A non-roughage ration containing only steam-rolled barley supplemented with adequate quantities of vitamin A, calcium, phosphorus, and sodium chloride; (2) a corn-cob-meal with 30 percent dried molasses beet pulp as a non-roughage ration; (3) levels of dried molasses beet pulp to mix with barley in a non-roughage ration; (4) the initial age and weight of the steer that could be fed a non-roughage ration composed of barley; (5) the length of time steer calves could be fed a non-roughage ration composed of barley; (6) the kind of roughage that could be fed in small quantities to steer calves fed a concentrate mixture composed of barley; (7) the length of time to feed a ration containing roughage previous to feeding a non-roughage ration; (8) the age and weight interval of steers that will give most efficient returns on the non-roughage ration; and (9) the contributions of feeding limited quantities of roughage with the concentrate mixture. The authors concluded that:

1. A non-roughage ration of steam-rolled barley gave more rapid and economical gains than corn-cob meal for steers with initial weights ranging between 700 and 800 pounds.
2. A non-roughage ration of steam-rolled barley with 15, 30, or 43 percent dried molasses beet pulp produced more economical gains than steam-rolled barley without the dried molasses beet pulp.
3. The non-roughage ration composed of steam-rolled barley with 15 percent dried molasses beet pulp was the most profitable mixture as measured by the cost of 100 pounds gain.
4. Steers fed the non-roughage ration of steam-rolled barley without dried molasses beet pulp suffered more from excessively high environmental temperatures than

steers fed the roughage-concentrate ration, corn-cob meal with dried molasses beet pulp, and steam-rolled barley with dried molasses beet pulp.

5. Feeding small quantities of roughage with all the concentrate they would consume produced slower gains than the non-roughage rations.
6. Feeding a small quantity of straw with the concentrate mixture (less than 2 pounds) reduced the efficiency of gains.
7. Steer calves with initial weights between 450 and 600 lbs. were not adapted to the non-roughage rations for periods of over 140 days. There was a reduction in rate of gains and feed efficiency.
8. The most economical returns were made by steer calves fed a high roughage mixture during the first 84 days followed by a non-roughage ration during the last 84 days.
9. The quantity of roughage to feed steer calves before feeding the non-roughage ration depends upon the price relationships of roughage to concentrates.
10. Steers weighing between 700 and 800 pounds may be finished on a non-roughage ration.

U. Idaho, Col. Agr. Idaho Agr. Expt. Sta., Moscow, Idaho.

241. Kearl, W. G. CATTLE-PRICE BEHAVIOR AND RANCHER'S DECISION MAKING. Wyo. Agr. Expt. Sta. B. 408, 20 pp. 1963.

The effects of variations in prices and weather conditions on the optimum times for marketing yearling feeder cattle in the Northern Plains area in Wyoming were investigated. The effects of four different price-phase situations were investigated for both normal weather and drouthy weather.

Under normal weather, marketing of yearling cattle is desirable as early as August 15 if prices are moving downward. With prices topping out, marketing around mid-September would be preferred. With prices stable or moving upward, marketing around October 1 would be the best.

Opportunity return, or, as it is more commonly called, opportunity cost, refers to the return which must be given up because a resouce or an input is not put to its best use but is used in a less desirable alternative use. Opportunity cost is particularly important in considering alternative uses for range forage. Grass may be grazed either in summer and early fall, or in late fall, and possibly in winter. Grass may also be grazed either by breeding animals which are to be retained, or by yearling animals and cull cows which are to be sold. If the range forage is utilized for any but the best alternative in a particular year, then some opportunity cost is incurred.

Under drouth conditions, cattle gains become very slow, or stop, by early July. The opportunity costs and other costs of holding cattle are also substantial in a drouth situation. The combination of slow or non-existent gains and high costs make it desirable to market yearling cattle early--around June 15 except when prices are trending upward or topping out.

Variation in marketing date in accordance with these short-term variations is probably desirable. Ranchers should plan for the long run, however, to stock their ranges with a breeding herd which will allow sufficient range to carry yearlings to mid-September.

U. Wyo., Agr. Expt. Sta., Laramie, Wyo.

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242. Kelley, P. L., and Manuel, M. L. THE COMPETITIVE POSITION OF KANSAS IN MARKETING BEEF. Kans. Agr. Expt. Sta. Tech. B. 129, 27 pp. 1963.

In recent years, Kansas has experienced a substantial increase in the production of finished beef cattle. This has been associated with an increase in grain sorghum production which has been partially induced by wheat acreage allotments. Adjustments are being emphasized in resource use in the Great Plains. Livestock production appears to offer some alternatives to the cash grain economy of the area. Supplementary activities in marketing and processing could be associated with economic development that might provide off-farm employment opportunities.

Spatial price equilibrium models were developed for the beef sector of the economy.

Conclusions drawn from this study were: (1) Anticipated increases in population and consumer disposable income are expected to create a substantial increase in the demand for beef in future years. By 1975, approximately 50 percent more beef will be consumed in the United States than in 1959. (2) Kansas has feed supplies available to increase the production of fed beef. (3) Kansas now ships most of its beef to the Eastern and Southeastern markets. And (4) by 1975, it is anticipated that Kansas will be shipping beef to the West on a regular basis. There is opportunity for Kansas to hold or even expand its market to the East and Southeast and at the same time to add a substantial market to the West. Consumption of beef in the West will increase more rapidly than production will increase in that region.

Agr. Expt. Sta., Kans. State U., Manhattan, Kans.

243. Amick, R. J. THE INFLUENCE OF SIZE OF ENTERPRISE AND OTHER FACTORS ON HOG PRODUCTION COSTS IN THE COASTAL PLAIN OF GEORGIA. Ga. Agr. Expt. Sta. Tech. B. N.S. 31, 43 pp. 1963.

The extent of economies of size of enterprise existing in the production of hogs was studied. The variation in the quantities of resources used in the production of hogs and the relationship between unit cost of producing hogs and other variables hypothesized to influence costs either directly or indirectly were studied.

The study was based upon empirical information obtained from a group of hog producers in the Coastal Plain of Georgia during 1959-60. Regression analysis was used to estimate an average cost curve for hog production in the area. There were economies of increased size of enterprise in hog production throughout the range of available data. This function indicated pronounced economies for increased output from low levels to an output of approximately 30,000 pounds of hogs (herd size of 15 sows). Beyond this level, cost continued to decline at a decreasing rate to an output of 80,000 pounds of hogs after which cost was almost constant.

Regression estimates of the relationship between the components of cost and size of enterprise indicated that the costs which decreased as size of enterprise increased were: (1) Feed costs; (2) labor costs; (3) building and equipment costs; and (4) interest, insurance, and taxes. As size of the enterprise increased, the cost of each of these factors decreased at a decreasing rate.

Although size of enterprise had a significant influence on cost, it was hypothesized that other variables also had an influence on production cost. These variables were: (1) Pounds of feed per 100 pounds of hogs; (2) hours of labor per 100 pounds of hogs; (3) investment (other than hogs) per 100 pounds of hogs; and (4) average weight of hogs marketed.

Regression techniques and residual analysis were used to estimate the effects of these four variables and size of enterprise on the cost of producing hogs. The level of feed efficiency accounted for more of the variation in cost than any other factor. The model used to

determine the relationship between feed efficiency and cost was linear, with cost decreasing as feed efficiency increased. This factor explained 53.6 percent of the total variation in cost. A 1/2 pound decrease in the feed required to produce a pound of pork decreased cost by $1.74 per 100 pounds.

Labor efficiency and capital efficiency were additional variates introduced to analyze the variations in cost which were unexplained by feed efficiency. These variables explained an additional 29.9 percent of the variation in cost of producing hogs. The combination of the three variables explained 83.5 percent of the total variation in cost. Size of enterprise had a significant effect on labor efficiency and capital efficiency.

Ga. Agr. Expt. Sta., U. Ga. Col. Agr., Experiment, Ga.

Institutional, Educational, and Social Factors Affecting Conservation Application

SEE ALSO 228, 229.

244. Rodewald, G. E., Jr., Larson, D. K., and Myrick, D. C. DRYLAND GRAIN FARMS IN MONTANA: HOW THEY STARTED, GROWTH, AND CONTROL OF RESOURCES. Mont. Agr. Expt. Sta. B. 579, 47 pp. 1963.

From 1910-60, farmers in Montana and the United States have been faced with many adjustment problems. Labor productivity had been greatly increased by mechanization. This increase in productivity, plus other economic factors, has made it necessary for farmers to acquire more land in order to fully employ their resources. Capital requirements for those entering or remaining in farming have increased.

How dryland grain farmers gain control of land and accumulate capital was determined. Data from a sample of farmers for two areas in Montana--the Triangle and Northeast--were used. The area data were divided into three time periods: Period 1--before 1940; Period 2--1940-49; and Period 3--1950-60. Data from secondary sources were used to supplement that from the sample farmers.

There were many changes in the methods of land acquisition used in the 50-year period. Some farmers in the Triangle and Northeast areas started by homesteading land in the 1910's. During the 1920's and 1930's there was a tendency to buy land. Since 1940, and particularly since 1950, the proportion of sample farmers starting by renting all their land has increased.

This shift in starting tenure can be attributed largely to the increased cost of land and other inputs used in farming. Over half the farmers starting prior to 1940 began with less than $4,000; since then the increased costs or inputs of production and family living have made it almost impossible for a person to start without considerable capital. In both areas, farmers starting during the 1950's began with an average of about $12,000.

Starting sizes of farms have changed. Prior to 1940, the average starting size was close to 500 acres, whereas in the 1950's it was over 1,000 acres. Economic conditions prevailing since 1940 have forced farmers to start on larger units.

Farmers attributed their success at farming largely to advancing technology, which was ranked highest among five factors. Years of schooling was ranked as least important.

Eighty-six percent of the sample farmers indicated they had fire insurance. Sixty-one percent carried some kind of crop insurance. The "blanket policy" was the popular type of liability carried by farmers.

Under the assumption of limited equity in the land, the capital accumulation budgets indicated it would be difficult, if not impossible, for a person to start as owner of all or

part of his land with less than 1,200 acres of cropland, and be able to pay for his farm and machinery solely from the farming enterprise. It appears that the best way for a person with limited capital to start farming is to rent all the land he intends to operate. A full tenant with limited equity in machinery would require a dryland grain farm of 1,640 acres of cropland to pay off the chattel mortgages in both areas. With these acreages, the full tenant could pay off his debts and still accumulate surplus capital in the beginning years. Later on, if his economic situation were favorable, he could purchase land. For the full owner with limited capital, the budgets indicated that no surplus capital beyond his payments could be accumulated with any size farm.

For a full owner with 1,640 acres of cropland in the Triangle area, about $49,000 would be needed to finance the first year's operation. A full tenant would need about $17,000. The actual amount of funds needed for the first year's operation would depend on starting tenure, size of farm, and the economic circumstances of the beginning operator.

Mont. Agr. Expt. Sta., Mont. State Col., Bozeman, Mont.

245. Armstrong, J. H., and Kohls, R. L. SEASONAL VARIATION IN INDIANA FARM PRICES. Ind. Agr. Expt. Sta. Res. B. 766, 15 pp. 1963.

Prices of certain agricultural products have somewhat regular patterns of high and low prices during the year. This information, wisely used, is one of the most important single types of information available to help the farmer market his farm products most advantageously. For products which are storable, price patterns can be valuable aids to help make proper decisions of when to sell. For products which cannot be stored but can have a varied time of production, seasonal price information may help in planning production so that supplies may be available at the most advantageous times.

Average seasonal price patterns help to answer three basic price questions:

1. How much total variation between the low price period and the high price period can be expected?
2. When are the most likely periods of lowest and highest prices during the year?
3. What is the direction of prices likely to be from one month to the next?

Average seasonal price information must be used with full knowledge of its limitations. It is based on average monthly prices and indicates only the periods of price weakness and strength. It does not indicate the particular day or week when highest prices will occur and it does not indicate perfectly what occurred in any particular year. It only indicates what prices have done over a long period--they may differ considerably from the average pattern in any one year. The seasonal factor is only one of several factors which influences prices. Average seasonal price variations represent the price movement during the year which might result if supply conditions are average and if the demand situation remains unchanged during the year.

Average seasonal price indexes change over the years. This is indicated in several instances by comparison of the 1950-54 and 1956-60 indexes. These changes are usually brought about through changes in production and marketing practices and may represent considerable evolution in the industry.

The limitations mean that the average seasonal price patterns is only one--though an important one--of many facts in analyzing future markets.

Purdue U., Agr. Expt. Sta., Lafayette, Ind.

246. Berry, R. L. FARM TENANCY PROBLEMS IN SOUTH DAKOTA. S. Dak. Agr. Expt. Sta. B. 510, 29 pp. 1963.

Whether or not share rent landlords should also share their tenant's operating costs was studied. A mail questionnaire was sent to 250 landlords and 500 tenants. One-third of the landlords and one-fourth of the tenants replied.

Almost all the landlords and tenants agreed that commercial fertilizer costs should be shared but that "all the cash operating costs" should not be shared as the product is shared under share rent leases. Most of them said that "all seeds" should be shared only when crops are shared 50-50. Three-fourths of all landlords and tenants said that tractor fuel, hired labor, and machinery-repair costs should not be shared. Three-fourths also said that cost sharing would neither increase yields nor reduce landlord tenant disagreement.

Over 80 percent of the tenants thought that long term leases should be used and that the landlord should compensate them for the unexhausted value of the improvements that they made. Only half the landlords agreed on these two points, but over 90 percent of both landlords and tenants agreed that ability to get along together was more important than a long-term lease.

The main reason why both landlords and tenants rejected cost sharing may well be that it decreases the ability to get along well together. In their comments, landlords and tenants often mentioned the disagreements, misunderstandings, and confusion that would result when many costs were shared. Cost sharing would be particularly difficult when the tenant owned land or leased land from more than one landlord. Fully 40 percent of the farmer in South Dakota are part owners that rent land from one or more landlords, and another 30 percent rent all their land--often from two or more landlords.

In general, tenants wanted greater fixity of possession, freedom of operation, and freedom of improvement--(the "Three F's").

Tables.

Agr. Expt. Sta., S. Dak. State Col., Brookings, S. Dak.

247. Mann, F. L., and Meeker, C. R. FATHER-SON AND OTHER FARM PARTNERSHIPS. Mo. Agr. Expt. Sta. B. 809, 26 pp. 1963.

A practical guide to farm people who desire to associate themselves together as partners in the organization of a farm business was given.

Two or more people may organize and operate a farm business under several different methods: (1) Employer-employee; (2) joint venture; (3) partnership; (4) limited partnership; (5) landlord-tenant; (6) debtor-creditor; and (7) corporation

Each of these may meet certain needs of people at various times.

Each of these different methods of operating a farm business has its advantages and its disadvantages. All possibilities should be considered and the one chosen should most nearly meet the needs of the situation and of the persons involved.

A discussion of one type of organization of the farm business--the farm partnership was given.

It is quite important to understand the type of relationship involved in a partnership and its legal implications. If it is not desirable nor intended to form a true partnership, then another type of organization should be used.

The written contract should describe the rights and duties of the parties. Its terms should clearly indicate the existence of a partnership if a partnership is to be created. Its

terms should likewise refute the existence of a partnership if the arrangement is not intended or desired to be one.

The farm partnership can be an excellent type of business organization. There are many successful father-son and other farm partnerships in operation on Missouri farms.

U. Mo., Agr. Expt. Sta., Columbia, Mo.

248. Stewart, B. E. RECREATIONAL USE OF PRIVATE LAND IN A PORTION OF EASTERN MAINE. Maine Agr. Expt. Sta. Misc. P. 658, 47 pp. 1963.

The recreational use of private land and roads in a portion of eastern Maine was investigated to: (1) Determine the opinions of the recreationists with respect to roads, facilities, and management; and (2) determine the opinions of the landowners and the representatives of those state agencies concerned with the recreational use of private land.

A one million acre study area was selected north and east of Bangor and questionnaires were developed to elicit the desired information from landowners, representatives of state agencies, and recreational users sampled during the various recreational seasons of January, 1959 to November, 1960.

The majority of recreationists interviewed were satisfied with roads, recreation facilities, and land management. A majority of recreationists indicated: (1) A willingness to pay for the improvements suggested through a use fee; (2) a desire for maps; (3) a knowledge of land ownership; and (4) numerous reasons for visiting the study area. The hunters differed from the other groups in that they were less willing to pay fees and were more critical of the land management. The opinions of residents did not differ from the opinions of non-residents except that a higher percentage of non-residents favored wilderness areas than did residents.

Landowners, although aware of the problems coincident with the recreational use of private land, were tolerant of recreational use of the land, but were disinclined to commit themselves to any extensive recreational development plans.

The representatives of state agencies commented to the effect that: (1) More recreational facilities were needed; (2) damage to facilities was negligible, (3) certain road improvements were needed; (4) fire permit policy needed improvements; and (5) the public needs to be educated in proper use of private land.

Maine Agr. Expt. Sta., U. Maine, Orono, Maine.

BIOLOGY

Fish

SEE ALSO 34.

249. Benson, N. G., and Bulkley, R. V. EQUILIBRIUM YIELD AND MANAGEMENT OF CUTTHROAT TROUT IN YELLOWSTONE LAKE. U.S. Dept. Int. Fish and Wildlife Serv. Bur. Sport Fisheries and Wildlife Res. Rpt. 62, $0.35. 1963.

Equilibrium yield of the cutthroat trout (Salmo clarki lewisi Girard) in Yellowstone Lake, Wyo., was determined from data on catch and spawning runs from 1945-61. Changes in growth rate, spawning runs, mortality rates, and year-class strength were related to

differences in total catch. Three stages of exploitation of the stock were defined, and the maximum safe catch or equilibrium yield was estimated at 325,000 trout. Management of the sport fishery according to equilibrium yield was discussed with reference to regulations, distribution of fishing pressure, planting, and interspecific competition.

For sale, Supt. Doc., U.S. Govt. Print. Off., Washington, D.C. 20402

Upland Wildlife

250. Dalke, P. D., Pyrah, D. B., Stanton, D. C., Crawford, J. E., and Schlatterer, E. F. ECOLOGY, PRODUCTIVITY, AND MANAGEMENT OF SAGE GROUSE IN IDAHO. J. Wildlife Mangt. 27(4): 811-841. 1963.

A study of the seasonal movements, productivity, and management of sage grouse (Centrocercus urophasianus) was undertaken by the Idaho Cooperative Wildlife Research Unit from 1952-60, on an area in Fremont and Clark, Counties, Idaho, directly west of Yellowstone National Park.

Nineteen individual strutting grounds 1/10-10 acres in size were located along 12 miles of the Red Road. Summer brood range was 13-27 miles north and northeast of the Red Road strutting grounds. Flocks of sage grouse began migrating west and southwest in October and November and traveled 30-50 miles, depending upon the depth of the snow. Winter concentrations were usually found where snow was less than 6 inches deep. Dispersal and return east and northeast to the breeding grounds began in late winter for a yearly round trip of 50-100 miles. The number of adult males increased quickly on strutting grounds, and the peak of breeding occurred April 7-21. Strutting grounds were abandoned early in May if there was a high ratio of adults to subadults. A late season peak of subadult males was often seen on strutting grounds after all other grouse had departed. Interstrutting movements of adult males varied from 22 to 53 percent and up to 4.3 miles from original banding sites.

Sexing criteria included plumage differences on chin, throat, breast, undertail coverts, and minor marginal tectrices; size of feet; wing length and length of primaries; and weights of adults. Identification of gonads provided the only ready internal diagnostic characteristics of sex. Aging criteria included measurement of bursa, and characteristics of outer two primaries, second primary covert, undertail coverts, and sternum. The mandible test was not reliable for adult sage grouse.

The high counts of males on strutting grounds provided a reasonably accurate method of determining breeding population trends. The method may be as much as 20 percent conservative because of cocks which are not on strutting grounds. The reproductive potential cannot be fully assessed without knowledge of the relative proportion of adult to subadult females. Ovulated-follicle counts as a measure of the number of eggs laid were unreliable, but were useful in determining the relative laying effort between yearlings and adult females.

Adverse weather during hatching appreciably lowered number of grouse available for fall hunting. Brood census on summer range was useful in determining reproductive success and was reliable until the third week in July, when brood structure began to deteriorate.

U. Idaho, Idaho Coop. Wildlife Res. Unit, Moscow, Idaho.

251. Ammann, G. A. STATUS AND MANAGEMENT OF SHARP-TAILED GROUSE IN MICHIGAN. J. Wildlife Mangt. 27(4): 802-809. 1963.

Sharp-tailed grouse (Pedioecetes phasianellus) have decreased at least 9 percent in the Upper Peninsula of Michigan since 1956, largely a reflection of the loss in habitat. In the

Lower Peninsula, sharp-tails are more abundant and somewhat more widespread in distribution than they were in 1956. From population trends correlated with open and closed hunting seasons on intensive study areas, it was judged feasible to replenish depleted spring breeding populations by prohibiting hunting on such areas.

Positive management measures for sharptails totaled 6,953 acres purposely burned and 10,849 acres sprayed with herbicide. Spraying or a combination of burning and spraying, where feasible, was the most practical measure for controlling woody cover. Life histories of 16-, 17-, and 18-year of sharptail populations on several areas that were repeatedly treated by burning and spraying showed varying responses by the sharptails but proved that sharptail populations can at least be maintained by intensive management--at a price.

In the future, sharptails will very likely be restricted to a few productive and intensively managed areas.

Mich. Dept. Conserv., Lansing, Mich.

252. Ritcey, R. W., and Edwards, R. Y. GROUSE ABUNDANCE AND JUNE TEMPERATURES IN WELLS GRAY PARK, BRITISH COLUMBIA. J. Wildlife Mangt. 27(4): 604-606. 1963.

A study of weather records and the annual grouse kill in Wells Gray Park, British Columbia, Canada, showed a relationship between June weather and the fall kill. A positive correlation coefficient of 0.913 was found to exist between the fall grouse kill and the mean maximum June temperature. The grouse involved were chiefly ruffed grouse (Bonasa umbellus). High temperatures in late spring and early summer are an important factor in the reproductive success of grouse.

Fish and Game Br., Dept. Recreation and Conserv., Kamloops, British Columbia, Canada.

253. Hamerstrom, F. N., Jr. SHARPTAIL BROOD HABITAT IN WISCONSIN'S NORTHERN PINE BARRENS. J. Wildlife Mangt. 27(4): 793-802. 1963.

Analysis of 207 records of habitats in which about 193 broods were found clearly shows why openings in forested areas are vitally important to sharp-tailed grouse (Pedioecetes phasianellus campestris). Eighty percent were in open cover; 14 percent were in edge types; and 5 percent were more than 50 yards into woods. The occurrence of broods in and near food patches, farm fields, weedy old fields, and abandoned food patches suggests that in the sandy, sterile soils of the Barrens, food patches may have an unappreciated value for summer food. The greens and insects which accompany cultivation may be even more important than the grains which have been planted.

Wis. Conserv. Dept., Plainfield, Wis.

254. Fay, L. D. RECENT SUCCESS IN RAISING RUFFED GROUSE IN CAPTIVITY. J. Wildlife Mangt. 27(4): 642-647. 1963.

With a modest investment in equipment and effort, employees of the Michigan Department of Conservation raised 126 ruffed grouse (Bonasa umbellus) to ages of 5 to about 9 weeks for experimental stocking. Eggs from wild nests were incubated in an electric incubator adjusted to $99\frac{1}{2}^{\circ}$ F. The chicks were reared with electric brooders started at

100^{o} -105^{o} F., in outdoor and in indoor facilities. They were fed commercial game-bird starter ration supplemented with small amounts of greens and provided drinking water medicated with terramycin. Hatching success from 219 eggs was 77 percent. Grouse survival was 76 percent of chicks started.

Rose Lake Wildlife Res. Cent., Mich. Dept. Conserv., East Lansing, Mich.

255. Jones, R. E. IDENTIFICATION AND ANALYSIS OF LESSER AND GREATER PRAIRIE CHICKEN HABITAT. J. Wildlife Mangt. 27(4): 757-778. 1963.

Essential components of the habitats of the lesser prairie chicken (Tympanuchus pallidicinctus) and the greater prairie chicken (Tympanuchus cupido pinnata) were analyzed comparatively on the basis of actual use by the birds. In general terms, the habitat of the lesser prairie chicken consisted of small units of shortgrass prairie intermixed with larger units of shrub or half-shrub vegetation; that of the greater prairie chicken consisted of small units of shortgrasses or midgrasses intermixed with larger units of tallgrasses.

Insects were the primary food resources of the lesser prairie chickens. Major foods of the greater prairie chickens were obtained from plants.

Day-resting lesser prairie chickens were found mostly in half-shrub vegetation; day-resting greaters used the edges of tallgrass and midgrass vegetation units. Both lesser and greater chickens chose units of moderately tall vegetation for night-roosting. Within these units, the actual roost sites were established where the vegetation was significantly shorter than most of the plants in the stand.

Courtship areas of both species were composed of shortgrass units. Nesting areas were located less than $\frac{1}{2}$ mile from courtship grounds. Nesting took place in areas of exceptionally heavy cover. When hatching was completed, greater prairie chicken females moved their broods into areas where the vegetation had been disturbed: Old fields; native shortgrasses; or cultivated pastures. This enabled the young to forage for insects associated with the forbs prevailing in these vegetation types. Lesser prairie chicken broods also utilized vegetation having abundant forb cover.

Okla. Coop. Wildlife Res. Unit, Okla. State U., Stillwater, Okla.

256. Lehmann, V. W., and Mauermann, R. G. STATUS OF ATTWATER'S PRAIRIE CHICKEN. J. Wildlife Mangt. 27(4): 713-725. 1963.

The Attwater's prairie chicken (Tympanuchus cupido attwateri) is extinct in Louisiana and has decreased to approximately 1,335 in Texas. The decline since the last comprehensive studies of the 1930's has been approximately 7,365 chickens or 85 percent. Intensified use of grasslands, exclusion of controlled fire, oil development, predator increase, and expanded rice farming (now under a control program which actually encourages the breaking of additional prairie and the use of cultivated acres to the absolute limits of capability) are largely responsible. The current wide use of agricultural chemicals may also be important.

Public sentiment favors a strong program to save Attwater's prairie chicken, a hallmark of the prairies that used to be. A program which conservation forces might apply immediately includes: Agreements with landowners; predator control; habitat improvement; transfer of chickens; establishment of a prairie chicken preserve; lease of nesting areas in fallow rice lands; multiple land-use management; continuation of closed season on prairie chickens; warning signs on roads; and enlarged life-history and management studies.

King Ranch, Kingsville, Tex.

257. Hoffman, D. M. THE LESSER PRAIRIE CHICKEN IN COLORADO. J. Wildlife Mangt. 27(4): 726-732. 1963.

Lesser prairie chickens (Tympanuchus pallidicinctus), now rare though increasing in numbers in Colorado, were once fairly common in the southeastern part of the state, particularly in the area south of the Arkansas River. The species has been observed in Colorado during the period 1959-62 only within the sand sagebrush-grassland plant communities and bordering cultivated fields.

A major reduction in lesser prairie chicken range and numbers in Colorado apparently coincided with the general pasture depletion during the dust-bowl conditions of the 1930's. Populations have been censused through spring counts of cocks on booming grounds from 1959-62. The numbers of cocks counted on the grounds have steadily increased over the 4-year period from 6 on 3 grounds in the spring of 1959 to 104 on 13 grounds in the spring of 1962.

Practices which have benefited the species in recent years include improved grassland management through rotation of pastures, moderate livestock use, and grass reseeding programs. Improved moisture conditions have also benefited the species.

Colo. Dept. Game, Fish, and Parks, Denver, Colo.

258. Jackson, A. S., and DeArment, R. THE LESSER PRAIRIE CHICKEN IN THE TEXAS PANHANDLE. J. Wildlife Mangt. 27(4): 733-737. 1963.

Trends in populations of lesser prairie chickens (Tympanuchus pallidicinctus) in the Texas Panhandle were investigated by censusing drumming grounds annually on two study areas during a 10-year period, 1952-62, for comparison with data from a census of the same areas in 1942.

Severe drops in populations came in 1952. The decline was triggered by onset of a major drouth lasting through 1956, but populations did not increase during a series of good rainfall years starting with 1957.

Changing land-use practices are responsible for keeping lesser prairie chickens at low population levels in the Texas Panhandle. The more important of these are: Overgrazing of cattle range, particularly in dry weather, resulting in displacement of the tall grasses; accelerated programs of aerial spraying with herbicides for brush control; and combine harvesting of grain sorghum in place of storage by stocking and shocking in the field.

Tex. Game and Fish Comn., Canadian, Tex.

259. Mohler, L. I. WINTER SURVEYS OF NEBRASKA PRAIRIE CHICKENS AND MANAGEMENT IMPLICATIONS. J. Wildlife Mangt. 27(4): 737-738. 1963.

Fall and winter counts of prairie chickens (Tympanuchus cupido pinnatus) showed that individual flocks on local home ranges contained more chickens in late fall than earlier, suggesting the practicability of winter population surveys. Chickens remained in winter mainly at areas where corn on small general farms provided food, and adjacent extensive grasslands on cattle ranches provided suitable roosting cover. Additional winter habitat could be developed by combining corn-growing and controlled grazing in selected areas.

Idaho Fish and Game Dept., Boise, Idaho.

260. Choate, T. S. HABITAT AND POPULATION DYNAMICS OF WHITE-TAILED PTARMIGAN IN MONTANA. J. Wildlife Mangt. 27(4): 684-699. 1963.

The ecology and structure of a population of white-tailed ptarmigan (Lagopus leucurus leucurus), residing during the summer near Logan Pass, Glacier National Park, were studied from early June to mid-September, 1959-62. Although ptarmigan were observed in a wide variety of habitats within the alpine zone, they showed a preference for areas having moderate rock cover, plentiful snow or water, and short, young vegetation.

During the breeding season, 21 males and 14 females used the study area (7.08 acres of ptarmigan habitat). Territoral males returned to the same sites year after year and occasionally had the same mates. Yearling males rarely established and mated in their first year, but yearling females bred successfully. Females occasionally returned to the same breeding areas. Few females born on the study area returned to it, but many males did.

Clutch size averaged 5.2 eggs (range 3-9). Nest parasitism was rare. Renesting occurred occasionally in phenologically early years. The percent of successful females varied from 35 to 82. Poor success was often caused by inclement weather. Hatching success was 85.5 percent. Brood size at flight age ranged from 3.25 to 3.47.

Despite a large variation in natality, the size of the adult population at Logan Pass varied little. Average adult annual mortality was 29 percent, lower than that reported for other galliform species. Chick mortality was 35-44 percent by the time of dispersal. Mortality of immature birds was 63 percent by the following spring. A life table based on these average mortalities indicates a maximum life-length of 15 years, a mean longevity of 3.02 years, and an annual mortality rate of 42.1 percent.

The Logan Pass population did not show the fluctuation in numbers reported for other species of ptarmigan and suggested for the tundra biome.

Mont. State U., Missoula, Mont.

261. Palmer, W. L., and Bennett, C. L. RELATION OF SEASON LENGTH TO HUNTING HARVEST OF RUFFED GROUSE. J. Wildlife Mangt. 27(4): 634-639. 1963.

Populations of ruffed grouse (Bonasa umbellus) were compared on hunted and unhunted areas through a population cycle--from a near high in 1950 through a low in 1956 and 1957 to another high in 1962. Population size on two study areas was determined by means of strip censuses and drumming counts on representative portions. Effect of hunting on the one population was determined from harvest data.

There was no correlation between population size and age ratios in the hunter's bag. A shortage of adult hens in the bag in 2 of the 3 poorest years may have been a result of high hen mortality during the spring nesting season brought on by subnormal temperatures. Population turnover from fall to spring averaged between 60 and 70 percent on hunted and unhunted areas alike. Although the kill by hunters averaged almost 30 percent of the one population, spring populations were comparable with those on the unhunted area.

Kill data for the hunted area, which received up to four times as much hunting pressure as other comparable areas in Michigan, suggest that a much longer hunting season would not substantially increase the grouse kill. Thus, a greatly extended hunting season on a statewide basis would seem to be readily justifiable.

Roy Lake Wildlife Res. Cent., Mich. Dept. Conserv., East Lansing, Mich.

262. Hale, J. B., and Dorney, R. S. SEASONAL MOVEMENTS OF RUFFED GROUSE IN WISCONSIN. J. Wildlife Mangt. 27(4): 648-656. 1963.

From 1951-58, 1,125 ruffed grouse (Bonasa umbellus) were livetrapped and banded on two study areas totaling 15,878 acres in northwestern Wisconsin. Banded birds were recovered through retrapping, hunter kills, accidental kills, and sight observations. These recoveries provided 615 individual movement records involving 441 grouse.

Juvenile grouse were more mobile than adults in the fall, with about one-fourth of the juvenile recoveries made more than 1 mile from the banding site. Most grouse in fall populations had relatively small ranges, although some individual birds, mainly juveniles, wandered extensively. Winter movements by all sex and age classes were similar, and more restricted than in fall. Males banded on drumming sites in spring were sedentary and normally returned to the same drumming site in one or more springs. Female grouse were consistently more mobile than males except in winter. Year-around average movements by juvenile and adult males were generally restricted to small areas, even though some individual birds covered relatively long distances.

Scattered 160-acre grouse management units in forested areas were preferable to a single large management area.

Wis. Conserv. Dept., Madison, Wis.

263. Moran, R. J., and Palmer, W. L. RUFFED GROUSE INTRODUCTIONS AND POPULATION TRENDS ON MICHIGAN ISLANDS. J. Wildlife Mangt. 27(4): 606-614. 1963.

Ruffed grouse (Bonasa umbellus) were successfully introduced on five of Michigan's Great Lakes islands where these birds were not found naturally. Wild-trapped grouse were established on High Island in 1956 and on Garden Island in 1957 at a stocking rate of five birds per square mile. A release of 63 hand-reared birds (parasite-free) on 3.5-square-mile Hog Island was an apparent failure. Regardless of island size, introduced grouse rapidly dispersed throughout the range and, according to spring drumming surveys and fall flush counts, reached maximum densities in four breeding seasons. The initial population surge resulted in abnormally high fall densities (flushing rates of 5-10 grouse per hour), although the highest spring breeding density calculated was five grouse per 100 acres. High fall populations apparently resulted from good nesting success rather than from unusual clutch size. Overwinter losses were between 60 and 75 percent.

Breeding numbers increased threefold and fourfold on High and Garden Islands, respectively, following one breeding season. After the second breeding season, spring populations doubled on High and tripled on Garden. Subsequent leveling off of spring densities coincided with the appearance of high fall populations. The Beaver Island control population established in 1948 peaked (out of synchrony with mainland trends) in 1954, but has since conformed to the normal cycle of grouse depression in the middle and late '50's followed by recovery in 1961-62.

Houghton Lake Wildlife Expt. Sta., Mich. Dept. Conserv., Houghton Lake Heights, Mich.

264. Yeatter, R. E. POPULATION RESPONSES OF PRAIRIE CHICKENS TO LAND-USE CHANGES IN ILLINOIS. J. Wildlife Mangt. 27(4): 739-757. 1963.

Censuses taken every spring from 1936-63 on booming grounds of a remnant prairie chicken (Tympanuchus cupido) population near Hunt in Jasper County, Ill., showed a gradual decline in numbers resulting probably from a progressive deterioration of habitat. This

deterioration involved the following factors: (1) A decrease in production of redtop (Agrostis alba), which formerly provided excellent nesting and brood cover for prairie chickens; (2) replacement of redtop by legume hays, which are often harvested at about the time when prairie chicken broods are hatching, with consequent destruction of nests and young birds; and (3) growth of intensive cultivation, resulting in destruction of grass cover in formerly idle fields.

Investigations on the 2,500-acre study area showed that topography as well as cover influenced distribution, with chickens generally preferring well-drained, gently sloping terrain. Conservation procedures recommended include: Purchasing land for refuges; leasing hayfields, and other small areas of grassy nesting cover; encouraging farmers to set aside strips of land along ditches, lanes, and possibly fences; and planting wild grasses on refuges.

Ill. Natural History Survey, Urbana, Ill.

265. Sharp, W. M. THE EFFECTS OF HABITAT MANIPULATION AND FOREST SUCCESSION ON RUFFED GROUSE. J. Wildlife Mangt. 27(4): 664-671. 1963.

Response of a ruffed grouse (Bonasa umbellus) population to a deteriorating habitat was studied for 6 years following 7 years of habitat manipulation. Manipulation of the habitat was accomplished by cutting operations, creating openings 1/4-1 acre in area in a 735-acre pole-timber forest. Regrowth of coppice from stump sprouting in the cuttings was undisturbed except for a few experimental plots where coppice was removed at 4-year intervals.

Conversion of openings to sapling stands was progressive. By the seventh season, these openings were losing the herb and other ground-layer vegetation because of shading. Grouse brood use began to decline. By the end of 10 years, the openings were filled in by a dense brushy canopy and were of little value as brood feeding grounds. Adult grouse were not affected by the closed-canopy forest because of their ability to move to favorable feeding sites. The population of adults declined because of deteriorating brood-range conditions and an adequate source of reproductive replacement from good brood habitats.

Forest Recreation and Wildlife Lab., Northeastern Forest Expt. Sta., Warren, Pa.

Wetland Wildlife

266. Hartman, F. E. ESTUARINE WINTERING HABITAT FOR BLACK DUCKS. J. Wildlife Mangt. 27: 339-347. 1963.

The food habits of black ducks (Anas rubripes) and the abundance and distribution of invertebrate food organisms were studied in the Penobscot Estuary, Maine, during the fall and winter of 1958-60 on mud flats and tidal marshes. Animal material, chiefly clams, constituted the bulk of the foods eaten. Other prominent animal items were snails and amphipods. Vegetable foods were more important in tidal-marsh habitat than on mud flats. Cordgrasses, primarily stems and leaves, were the principal vegetable food. A definite relationship existed between the availability of food organisms and the kinds of foods consumed by black ducks. The mud flats containing the largest numbers of clams usually attracted the largest numbers of feeding ducks. Feeding areas of vital importance consisted of small portions of mud flats that remained ice-free during periods of severe icing. These areas were emergency feeding spots for the ducks.

In a management plan for black ducks in an estuary, it is important that mud flats heavily utilized by feeding ducks, and emergency feeding spots, be preserved. These essential areas can best be identified by direct observation.

Pa. Game Comn., Div. Res., R. D. No. 2, Jonestown, Pa.

267. Birkenholz, D. E. A STUDY OF THE LIFE HISTORY AND ECOLOGY OF THE ROUND-TAILED MUSKRAT (NEOFIBER ALLENI TRUE) IN NORTH-CENTRAL FLORIDA. Ecol. Monog. 33: 255-280. 1963.

A study of the life history and ecology of the round-tailed muskrat (Neofiber alleni True) was conducted on Paynes Prairie, near Gainesville, Fla., from 1958-61. A total of 326 animals were utilized for analyses of catch composition, reproduction, and other aspects of the biology.

The most suitable round-tailed muskrat habitats were single dominant, shallow marshes with dense stands of Panicum hemitomon or a Panicum-Pontederia lanceolata mixture. This vegetative composition was best developed where water was 6 to 18 inches deep and the substrate was sandy. This habitat was highly vulnerable to water level fluctuations.

The homesites consisted of tightly woven, nearly spherical, grass houses used by single adults and feeding platforms and covered feeding shelters which might be shared. Houses were used for as long as 5 months, the period of use depending upon amount of cover present and fluctuation of water level. Animals burrowed beneath vegetation layers when marsh bottoms were exposed during drought.

Neofiber alleni is nocturnal. The diet is entirely herbivorous, composed primarily of Panicum hemitomon stems and roots.

Males comprised approximately 56 percent of all age classes. Round-tailed muskrats attained sexual maturity when approximately 90-100 days of age and at a weight of 230-280 grams. Males remained fertile after becoming mature. Breeding was correlated with the presence of favorable water levels and cover conditions. Most reproduction occurred in the late fall and early winter. The gestation period was calculated to be 26-29 days. Litter size averaged 2.2 in 104 females. Average number of ova produced was 2.7. Prenatal loss seemed insignificant. Realized number of litters per year appeared to be four or five for a realized natality of approximately eight young per year.

Growth and development were recorded for five litters, totaling nine young, that were born in captivity. The young averaged 12.0 grams at birth. The incisors extruded at 2 days of age, molars at about 10 days, and the eyes opened at about 14 days. The young were weaned by 3 weeks of age.

The animals pass through two molts to obtain the adult pelage. Molting of adults occurred throughout the year, with an increased prevalence in the fall. Young round-tailed muskrats resembled the smaller microtines in rate of development.

Data on home range were obtained by injecting animals with radioactive phosphorous, then determining feeding areas by locating radioactive feces on feeding platforms. The data from four animals indicated that feeding was restricted to an area about 30 feet in diameter; however, they wandered over a larger area. Maximum densities of Neofiber was approximately 100-120 animals per acre of habitat.

Populations seem to be regulated by environmental conditions, primarily water level fluctuations, which alter the habitat. Predation by raptors reached high proportions after flooding, but was normally a minor and secondary mortality factor. The young were more adversely affected by displacement than adults.

Parasitism or disease did not seem to be an important factor in mortality. Mites, the only ectoparasites found, were present on nearly all specimens examined.

U. Fla., Gainesville, Fla.

268. Laramie, H. A., Jr. A DEVICE FOR CONTROL OF PROBLEM BEAVERS. J. Wildlife Mangt. 27: 471-476. 1963.

Beaver (Castor canadensis) dam-induced flooding has been controlled by use of beaver pipes in New Hampshire. These pipes, of fiber or wood and with multiple small openings

along the length of the bottom portion, are placed through the dam and into the beaver pond. Height of outlet and length of pipe are factors in producing the desired water level. Installation of wire-mesh guards across the mouths of culverts tends to discourage rebuilding in culverts after the existing dam has been removed.

New Hampshire now has 46 beaver dams with pipes installed and working well. All installations must be checked monthly and maintained as required. Beaver pipes are most useful on watersheds of less than 10 square miles. If culverts are involved, the maximum usable watershed is reduced to 4 square miles.

N.H. Fish and Game Dept., Concord, N.H.

SUPPLEMENT

Problems Indirectly Affecting the Application of Soil and Water Conservation Practices

269. Johansen, C., Jaycox, E. R., and Hutt, R. THE EFFECT OF PESTICIDES ON THE ALFALFA LEAFCUTTING BEE (MEGACHILE ROTUNDATA). Wash. Agr. Expt. Sta., Sta. C. 418, 12 pp. 1963.

The effects of pesticides on the alfalfa leafcutting bees were studied. The authors concluded that:

1. The leafcutting bee, Megachile rotundata, was more susceptible than the honey bee to many pesticides commonly used in pest control on alfalfa.
2. The following materials were moderately to highly toxic to leafcutting bees, depending on application rate, time of application, age of residue, and other variables: Malathion, parathion, endrin, sevin, DDT, toxaphene, toxaphene plus DDT, toxaphene plus dibrom, and American Cyanamid CL-43064.
3. The following materials were only slightly toxic to leafcutting bees by residual action: Dylox, demeton, diatomaceous earth, and kelthane.
4. Leafcutting bees were less susceptible than honey bees to poisoning by dylox and sevin.
5. Preliminary tests of the hazard of insecticide contamination of leafcutting bee nests were inconclusive but indicated no extreme problem from residues of DDT plus toxaphene, toxaphene, or dylox.

Wash. Agr. Expt. Sta., Inst. Agr. Sci., Wash. State U., Pullman, Wash.

Minn. Farm and Home Sci. 20(3): 3-24. 1963.

This issue of Minnesota Farm and Home Science was devoted to the use of chemicals in Agriculture. The following articles were written by staff members of the U. Minn.:

270. Hueg, W. F., Jr. AGRICULTURAL CHEMICALS AND MANKIND.

271. Dirks, H. J., and Hyslop, J. D. ECONOMIC CONTRIBUTIONS OF AGRICULTURAL CHEMICALS.

272. Lofgren, J. A. INSECTICIDES IN AGRICULTURE.

273. Cutkomp, L. K. INSECTICIDE USEFULNESS AND RESEARCH APPROACH.

274. Hanson, H. L. CHEMICALS FOR WOODY PLANT CONTROL.

275. Linck, A. J. THE FATE OF CHEMICALS IN PLANTS.

276. MacGregor, J. M. CHELATES IN SOILS.

277. Andersen, E. T. IRON UPTAKE BY STRAWBERRY PLANTS.

278. Caldwell, A. C., MacGregor, J. M. and Martin, W. P. THE MINNESOTA FERTILIZER STORY.

279. Behrens, R., and Otto, H. HERBICIDES IN MINNESOTA AGRICULTURE.

280. Hanson, L. E. FEED ADDITIVES.

281. Pomeroy, B. S. CHEMICALS TO CONTROL POULTRY DISEASE.

282. Stowe, C. M., and Sisodia, C. S. THE EXCRETION OF CHEMICALS IN MILK.

283. Glass, R. L. CHEMICAL ADDITIVES IN FOODS.

284. Davison, S. WASHABILITY OF CHEMICALLY TREATED BLANKETS.

U. Minn., Agr. Expt. Sta., St. Paul, Minn.

285. Hough, W. S. RESISTANCE TO INSECTICIDES BY CODLING MOTH AND RED-BANDED LEAF ROLLER. Va. Agr. Expt. Sta. Tech. B. 166, 32 pp. 1963.

Resistance in a population of insects refers to increased difficulty of control with an insecticide that formerly was quite effective. Since the use of organic insecticides became widespread, examples of control failures have multiplied to the extent that resistance to insecticides is a serious problem.

Results of investigations pertaining to resistance exhibited by the codling moth (Carpocapsa pomonella (L.)) and the red-banded leaf roller (Argyrotaenia velutinana (Wlkr.)) in northern Virginia were summarized. Because control is part of the resistance problem, attention was given to different treatments that might improve efficiency of control.

A brief review of the principal kinds of insecticides applied by orchardists in northern Virginia to control codling moths and red-banded leaf rollers was given.

Larval and adult stages of both codling moth and red-banded leaf roller were vulnerable to insecticides currently used in apple orchards. Guthion was effective against adults of both insects and against codling moth larvae for an extended period after an application, but it showed low toxicity to leaf roller larvae. Malathion was similar to Guthion against adults of both insects, but was low in residual toxicity to larvae. Parathion was similar to Malathion in performance, except residual effectiveness declined more rapidly against codling moth adults. Sevin was highly effective against adults of the codling moth for a few days after application, but some leaf roller moths survived exposure to 2-day-old residues.

Like Guthion, Sevin was highly effective against codling moth larvae for about 3 weeks or longer, but control of leaf roller larvae ranged from only 69 percent to 91 percent.

In view of the mogh-killing properties of certain insecticides, adjusting spray applications to destroy adults as well as larvae of each brood should increase efficiency of control of codling moth and red-banded leaf roller.

Va. Polytech. Inst., Agr. Expt. Sta., Blacksburg, Va.

286. Jenkins, L. NEMATODE RESEARCH FROM 1956-1962 IN MISSOURI. Mo. Agr. Expt. Sta. Res. B. 833, 40 pp. 1963.

The nematode-fusarium wilt problem on cotton can be controlled by the use of a soil fumigant or by the use of a resistant variety. The use of a resistant variety such as Auburn 56 has been the most practical solution under Missouri conditions. There was no increase in yield from the use of soil fumigants on this variety.

Damage to soybeans by the soybean cyst nematode is quite variable from one season to another. Presently available soil chemicals are too expensive for practical use.

There is a wide difference in the susceptibility of soybean varieties to the root-knot nematode (Meloidogyne incognita acrita.) The Scott variety was severely damaged by root-knot nematodes under conditions where the varieties Lee and Hood were only slightly damaged.

Sugar beets grown on sandy soil in southeastern Missouri are often severely damaged by root-knot nematodes. The use of DD at 8-1/2 gallons per acre as a row treatment gave satisfactory control of root-knot nematodes on sugar beets where the rows were spaced 38 inches apart.

Truck crops such as carrots, beets, okra, bush beans, sweet potatoes, muskmelons, cucumbers, and tomatoes are very susceptible to injury from root-knot nematodes when grown on sandy soil in southeastern Missouri. A soil fumigant such as dibromo chloropropane has given satisfactory control of nematode problems on all of the above crops except sweet potatoes and beets. DD was used successfully to treat areas planted to sweet potatoes and beets. Peppers showed no increase in yield when grown on soil treated with DD.

The following varieties of tomatoes when compared to Rutgers were resistant to root-knot nematodes; Kalohi, N-11, and TFX Kalohi.

U. Mo., Col. Agr., Agr. Expt. Sta., Columbia, Mo.

287. Knierim, J. A. NEMATODES ASSOCIATED WITH CROP PLANTS IN MICHIGAN. Mich. Agr. Expt. Sta. Q. B. 46(2): 254-262. 1963.

Nematodes were recovered from 650 soil samples collected from 55 species of plants and fallow fields in 37 counties.

Root lesion nematodes, Pratylenchus, were the most prevalent being found in association with 43 of the 55 plant species sampled, in 33 of the 37 counties, and in 64.9 percent of the samples processed. Species of one or both of the genera Pratylenchus and Xiphinema were associated with nearly every fruit tree replant problem examined. Members of Xiphinema were also important pests on many other fruits, vegetables, and nursery crops.

The root knot nematode (Meloidogyne hapla) was prevalent in some nursery crops and on vegetable crops grown on muck soils.

Species of the genus Paratylenchus were associated with numerous crops, however, their importance as a pest on most plants was questionable. Members of the genus Trichodonus were associated with several crops exhibiting poor vigor.

Mich. State U., Agr. Expt. Sta., East Lansing, Mich.

771-426 O-65—10

288. Holtzmann, O. V., and Ishii, M. STUDIES ON THE CONTROL OF ROOT-KNOT AND RENIFORM NEMATODES WITH SOIL FUMIGATION IN HAWAII. Hawaii Agr. Expt. Sta. Tech. Prog. Rpt. 139, 6 pp. 1963.

Root-knot (Meloidogyne spp.) and reinform (Rotylenchulus reniformis) nematodes attack a wide range of crops in Hawaii. Year-round production of many vegetable crops is frequently possible because of a moderate winter climate. Although chemical control of nematodes in Hawaii is being practiced by some growers, little is understood as to the factors which affect the efficacy of the soil fumigation.

The objectives of these studies were: (1) To determine the relative effect of nematocides on root-knot and reniform nematodes in the field; and (2) to determine whether fumigation in a particular growing season had an effect on crop yield.

All the chemicals tested were relatively effective in reducing the initial soil population of both root-knot and reniform nematodes. The nematocidal effect of DBCP was less in the initial kill of the reniform nematode than it was with the root-knot nematode. The reduction in bean yield was probably due to the root-knot rather than to the reinform nematode infestation.

Bean yields were significantly increased in the treatments EDB (96 lb./A.), methyl bromide, Telone (400 lb./A.), and EDB (48 lb./A.) in the summer-harvested test, whereas no significance was determined between the yields of the treatments in the winter-harvested test. The yield of the untreated check in the winter test outyielded that of the summer test despite the fact that the roots of the beans in the winter were more heavily galled with root-knot nematodes.

The bean roots in comparative DBCP treatments were less heavily galled in the winter test than in the summer test. DBCP has a lower vapor pressure than does EDB or Telone, thus is able to act nematocidally over a longer period of time.

Hawaii Agr. Expt. Sta., Col. Trop. Agr., U. Hawaii, Honolulu, Hawaii.

289. Polivka, J. B. CONTROL OF HAIRY CHINCH BUG, (BLISSUS LEUCOPTERUS HIRTUS, MONT.,) IN OHIO. Ohio Agr. Expt. Sta. Res. C. 122, 8 pp. 1963.

The 1961 tests indicated that a single application of several different insecticides, such as DDT, phorate, carbophenothion, ronnel, Sevin, Zytron, V-C 13, diazinon, lindane, and ethion, was effective in controlling the hairy chinch bug during the summer. Bayer 29493, Chinch Bug Killer, and Dylox were fairly effective against the first generation but failed to prevent the build-up of the second generation of the hairy chinch bug, except that carbophenothion and Bayer 29493 were not as effective as they were in 1961 despite the fact that they were applied twice during the summer.

Ohio Agr. Expt. Sta., Wooster, Ohio.

290. Cutright, C. R. THE EUROPEAN RED MITE IN OHIO. Ohio Agr. Expt. Sta. Res. B. 953, 32 pp. 1963.

The more important facts regarding the biology and control of the European red mite were given. In unsprayed orchards, the low numbers of mites are due to natural control which cannot operate under the conditions imposed by the use of a modern spray program for insects and diseases. Therefore, sprayed orchards are subject to serious infestations. Numbers of mites either great or small at any seasonal period depend on: (1) Initial population; (2) weather conditions; (3) natural enemies; (4) varieties; and (5) the spray program in use. Resistance is a very serious factor in control and in order to combat it most effectively, a program of rotational spraying was advised.

Due to the large number of miticides that are available, many different spray schedules of a rotational nature may be planned. Oil, chlorbenside (Mitox), or Genite 923 could be used in early season and then an organo-phosphate used in midsummer. The next year a different one of the first three could be used and in midsummer a chlorinated hydrocarbon could be employed. In the third season, a sulfur-based material in midsummer could follow the third remedy for early use.

A somewhat simpler schedule is probably to be preferred. Since no resistance has developed to the use of the oils, an application of oil could be used in the early season and then in midsummer a material from one of the three major groups (the organo-phosphates, the chlorinated hydrocarbons, and the sulfur-based) could be used in rotation. Such a schedule has been used in one of the experimental orchards at Wooster for the last 6 years and excellent control of mites has been secured.

Ohio Agr. Expt. Sta., Wooster, Ohio.

291. Wilson, J. D., Hedden, O. K., and Sleesman, J. P. SPRAY DROPLET SIZE AS RELATED TO DISEASE AND INSECT CONTROL ON ROW CROPS. Ohio Agr. Expt. Sta. Res. B. 945, 49 pp. 1963.

A revolutionary change in the techniques of row-crop spraying in the late 1940's and early 1950's resulted in a reduction in the quantity of water used to spray a unit area, accompanied by a corresponding increase in the concentration of the active ingredient in the spray formulation to maintain the same rate of pesticide use per unit area. This reduction in the application rate and the use of more concentrated spray mixtures was necessarily accompanied by a change in the size of nozzle (disc or tip) apertures and/or a reduction in pump pressures to provide the desired reduction in spray volume.

In an effort to determine the comparative effectiveness of spray droplets of different sizes in the control of diseases and insects on row crops, a cooperative experimental program was initiated in 1952.

In a series of experiments on potatoes, eggplants, cabbage, and tomatoes, droplets of 300-500 microns MMD (mass medium diameter) gave essentially the same control of both diseases and insects as those of 100-175 microns MMD except on tomatoes in 1955 when the 100-135 micron MMD gave the best control for anthracnose.

Flat and hollow-cone spray patterns gave approximately the same degree of disease control when the remaining features of the application techniques were the same or similar. The use of as few as 20 gallons of water per acre usually gave as good results in terms of disease control as did other application rates as high as 160 gallons.

In a 1961 experiment on sugar beets for the control of leaf spot (Cercospora), droplets as large as 500 microns MMD gave approximately as good results as did others as small as 100 microns. Flat and hollow-cone spray patterns gave essentially the same degree of disease control, with the former slightly the better. The initial and weathered deposits of copper were higher with low gallonage-low pressure applications (large spray droplets) than with high gallonages and pressures (small drops).

Ohio Agr. Expt. Sta., Wooster, Ohio.

292. Anthony, W. B., Starling, J. G., Brogden, C. A., Nix, R., and Harris, R. R. DEHYDRATED-PELLETED PEANUT VINES--A NEW ENTERPRISE FOR PEANUT FARMERS. Highlights Agr. Res. 10(2): 5. 1963.

Dehydrated and pelleted peanut vines may become a valuable by-product of the 200,000-acre peanut crop in Alabama.

Preliminary research conducted in 1962 shows that dehydrated and pelleted peanut vines have high nutritive value and harvesting vines is beneficial to the nut-thrashing operation.

Peanut vines were cut with a conventional forage chopper fitted with a sickle bar attachment and harvested just ahead of the conventional digging operation. The vines were hauled to a dehydrator and processed immediately into a pelleted product. The material was fed to steers and lambs.

Chemical composition and digestibility data for the peanut vines were given. Although the crude protein is a little lower than the content of crude protein in the usual commercial alfalfa meal, the composition data are very similar to that of alfalfa. The carotene content is especially high. The cellulose is lower in the vines than is usual in Alabama hays and this is desirable.

The following two problems must be overcome if the peanut vines are to be direct cut and used for feed. (1) Presently the peanut crop is treated with DDT which renders the forage unfit for feed. This may be overcome by using Sevin instead of DDT. And (2) in the peanut growing area there must be established facilities for dehydrating and pelleting the vines. The harvest period is of short duration and the dehydrating plants would need to obtain other crops to process to extend the period of operation.

Wiregrass Substation, Ala. Agr. Expt. Sta., Headland, Ala.

293. Ray, M. L., and Child, R. D. RICE HULLS IN STEER FATTENING RATIONS. Ark. Farm Res. 12(4): 7. 1963.

An 84-day finishing trial was conducted at Fayetteville, Ark., to determine the usefulness of a 12 percent protein-level rice hull mix as a roughage for fattening yearling steers. The mix was compared with No. 1 Oklahoma prairie hay.

The protein level of the rice hulls was raised to 12 percent by adding 400 pounds of 50 percent soybean meal to 1,600 pounds of ground rice hulls.

The steers were offered ad libitum two parts of grain mix to one part of roughage. In addition all animals had access to water, salt, and a mineral mix ad libitum and all were implanted with Synovex-S at the start of the feeding period.

Results, measured in terms of gain, feed efficiency, cost per hundredweight of gain, and carcass grade, are presented in the table.

Table Results of 84-Day Finishing Trial

Measure	Prairie hay ration	12% rice hull ration
No. of steers	8	10
Av. initial weight (lb.)	711	692
Av. final weight (lb.)	957	932
Av. gain (lb.)	246	240
Av. daily gain (lb.)	2.93	2.86
Feed per lb. gain (lb.)	8.5	7.9
Feed cost per cwt. gain [1]	$19.79	$17.24
Carcass grades		
Choice (no. of steers)	1	1
Good (no. of steers)	7	9

[1] Feed costs per ton: grain mix, $52; prairie hay, $26; rice hulls, $8; soybean meal, $84.

Carcass data were collected on all steers. One steer in each lot graded U.S.D.A. Choice, while the others graded Good. No differences were observed in color of lean, color of fat, degree of marbling, dressing percent, or shrink in transit to market.

None of the differences observed were significant when subjected to statistical analysis. There was no bloat, scours, hemorrhage, or other ill effect observed from feeding rice hulls as the only source of roughage.

Agr. Expt. Sta., U. Ark., Fayetteville, Ark.

294. Hill, R. D., Malaney, G. W., Schwab, G. O., and Weiser, H. H. EVALUATION OF POND WATER TREATMENT SYSTEMS. Ohio Agr. Expt. Sta. Res. B. 957, 51 pp. 1963.

Water supply problems have become critical to many farm and suburban dwellers in Ohio. The trend toward larger farm units with greater numbers of livestock per unit, confined housing of livestock, pipe line milkers, bulk milk tanks, on-farm processing, and modern household equipment has increased water usage on the farm. Water sources, in many cases, are not adequate for this increased demand because of insufficient quantity or poor quality water. Cisterns are not capable of storing water for large farm operations. Dug wells are often contaminated and go dry in the summer. There are large portions of Ohio in which well yields are 5 gallons per minute or less due to poor underground water resources. The search for other sources of water have led many to the farm pond--first, as a livestock water supply, and later as supplemental household, milk house, and barn supply, and in some cases as a domestic water supply. With the popularity of farm ponds today (estimated at 35,000 in Ohio at the end of 1962 and being built at the rate of 2,000 per year) their increased use as a water supply can be expected.

Twelve farm pond water treatment systems constructed and maintained by home owners were evaluated. The authors concluded that:

1. None of the 12 systems produced a continuous supply of water that met the Drinking Water Standards.
2. The two major problems were poor filtration and disinfection.
3. The slow sand filters and rapid sand filters investigated were not effective in reducing the turbidity and apparent color to a suitable concentration when raw water quality was poor. Pretreatment with alum before filtration with a rapid sand filter improved its performance.
4. Carbon dechlorinators were effective in reducing turbidity, color, odor, and chlorine, but had limited life. Where chlorine was fed before a sand filter, the filter reduced the chlorine concentration.
5. Chlorination was not effective primarily because of the shortage of chlorine-water contact time in home water systems, apathy of the home owner, and other factors not identified.
6. Surface intakes in the pond and a concrete block box without gravel produced better quality water than other methods of removal.

Ohio Agr. Expt. Sta., Wooster, Ohio.

295. O'Neil, W. J. TESTS ON TREATED FENCE POSTS. Mo. Agr. Expt. Sta. B. 808, 9 pp. 1963.

Experiments on treated fence posts were carried out at Columbia, Mo., commencing in 1938 and near Weldon Spring, Mo. commencing in 1955. The author concluded that:

1. The species may be grouped into the following durability categories: (1) Durable--most posts will endure for 20 years (catalpa, eastern redcedar, and black locuts);

(2) moderately durable--most posts will endure from five to 15 years (Chinkapin oak, white oak, black oak, and shortleaf pine); and (3) non-durable--most posts will not endure for 5 years (ash, basswood, cottonwood, American elm, hackberry and hickory).

2. If untreated posts are used, they should be made from a durable species and should contain heartwood with a diameter of at least 3 inches at the butt end.
3. The most successful treatment was creosote pressure treatment.
4. After 7 years, 99 percent of the posts treated with Pentachlorolphenol were still serviceable.
5. The 2-1/4 hours hot bath followed by a 1 hour cold bath was the most successful non-pressure treatment. Forty-three percent of the posts treated by this method were serviceable after 23 years. This treatment gave an average life for all species of 15 years and prolonged the life of all species.
6. After 7 years, 88 and 79 percent of the posts given the double diffusion treatment were still serviceable.
7. The posts given Osmose-salts treatment were 59 percent serviceable after 7 years.
8. The posts given the zinc chloride treatment where the entire posts were soaked for 1 week were serviceable for 11 years.
9. The zinc chloride tiretube method gave basswood a slightly longer life than black oak, 14 years against 13 years.
10. Basswood and black oak posts given the osmoplastic ground line treatment were serviceable for nearly 5 years and 15 years respectively. Applying the Osmolit treatment to the entire post of basswood and black oak resulted in a serviceable life of 3 and 14 years respectively. Both treatments obviously were ineffective on basswood but, were reasonably effective on black oak.
11. Painting posts with hot creosote or carbolineum was not effective in increasing the serviceable life of posts.
12. No treatment of basswood posts other than the zinc-chloride tiretube method increased the serviceable life enough to warrant the cost.
13. The service test of posts treated by the double diffusion method was not extended over a long enough period to justify a final appraisal of the results. However, it appears as though this method will not be as effective as the pentachlorolphenol or creosote methods in prolonging the serviceable life of posts.
14. For persons who wish to produce and treat their own posts, either creosote or pentachlorolphenol may be used as a preservative. If creosote is used, the seasoned posts should be left in a hot bath at 220° F. for 2 hours, and then placed in a cold bath for 1 hour. If pentachlorolphenol is used, the seasoned posts should be soaked in a 5 percent solution of the preservation in No. 2 fuel oil for no less than 24 hours.

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Radioactive Fallout

296. Frere, M. H., Menzel, R. G., Larson, K. H., Overstreet, R., and Reitemeier, R. F. THE BEHAVIOR OF RADIOACTIVE FALLOUT IN SOILS AND PLANTS: A REVIEW PREPARED FOR THE COMMITTEE ON EFFECTS OF ATOMIC RADIATION ON AGRICULTURE AND FOOD SUPPLIES. Natl. Acad. Sci., Natl. Res. Council P. 1092, 32 pp. $1.00. 1963.

Radioisotopes in fallout enter plants by three principal pathways: (1) Direct absorption by the aboveground parts; (2) absorption by the stems and roots from the root mat of

grass; and (3) absorption by the roots from the soil. Contaminated soil adhering to the aboveground parts of the plants may contribute to the observed uptake of fission products.

Foliar deposition and absorption depend on the surface area of the aboveground portion of the plant and the characteristics of the surface. The greater the surface area, the greater the interception per plant. Pubescence increases the retention of the fallout dust against washing and therefore the period of absorption. Many elements seem to be absorbed, some to a greater extent than through the roots. Fallout particles can be washed from the leaf surface, and even small amounts of absorbed elements can be leached from the leaf.

Plant-base absorption is a relatively recent concept and its general contribution has not been adequately evaluated.

No single crop of plants has been reported to absorb from the soil as much as 10 percent of the applied dose of fission products. There are two main reasons: (1) The soil has an affinity for the fallout nuclides because most of them are cations; and (2) the plant itself discriminates against them to a certain extent. The uptake of short-lived isotopes, such as barium-140 and iodine-131, through the roots is relatively unimportant as most of the isotope decays during the period required for it to reach the roots.

The uptake of cations by roots is probably by a carrier mechanism. Strontium and calcium compete for the same binding sites on this carrier, whereas cesium and potassium compete for another common site.

With the exception of strontium, and possibly cesium, the longer-lived fission products are taken up in relatively small amounts.

Because strontium is chemically similar to calcium, the strontium content of plants is often reported as a strontium-to-calcium ratio as well as an absolute amount of strontium. Both values have some importance in assessing hazards in the subsequent links of the food chain. The usual maximum uptake of strontium appears to be about 1 percent of the applied dose per crop. The average DF for strontium to calcium between the soil and plant tops appears to be close to unity. This factor varies among plants and even among different parts of the same plant and by different soil extractants. Variations in the root zone and differences in the vertical distribution of fallout strontium-90 and calcium in the field can have greater effects.

The average maximum uptake of cesium appears to be about 1/10 of 1 percent of the applied dose. The cesium-to-potassium DF is small--about 0.2 for uptake in nutrient solutions and 0.02 for additions to the soil.

In general, it appears that grasses accumulate less strontium than legumes. The fruit and seeds contain less strontium than the leaves or stems because strontium tends to accumulate in the vascular tissues of the plants. In contrast with strontium, which only moves readily upward, cesium is easily translocated throughout the plant, with perhaps slightly higher accumulation in young leaves and flowers.

Strontium and cesium are retained in the soil partly by ion-exchange bonds on clay minerals and organic colloids. A part of the strontium may be synthesized into organic compounds by the microbial population. A third means of retention in the soil can involve fixation processes. A large fraction of cesium-137 appears to be fixed irreversibly. Exchangeable strontium is leached through soils at the rate of about 1 inch per 100 inches of leaching water. The downward movement of strontium, and probably cesium, is essentially an exchange reaction and proceeds by successive desorption-adsorption sequences.

The soil that will provide minimum uptake of fission products appears to be one considered ideal for maximum crop production. These requirements include high exchangeable calcium, high exchangeable potassium, high organic-matter content, and a slightly alkaline reaction.

Bibliography.

For sale, Natl. Acad. Sci., 2101 Constitutional Ave., N.W., Washington, D.C.

297. Kruger, P. METEOROLOGICAL INFLUENCES UPON SR^{90} DEPOSITION RATES BY PRECIPITATION. Internatl. Conf. Radioactive Pollut. Gaseous Media, Saclay, France Nov. 12-16, 1963, 31 pp. 1963.

Meteorological analysis of several types of precipitation-producing storm systems were combined with radiochemical analysis for fission nuclear debris deposition through precipitation. Temporal and spatial distributions of fallout concentrations were examined for: (1) Large-scale uplift systems in central Pennsylvania; (2) convective shower activity in central Pennsylvania and, Oklahoma; (3) Pacific Ocean cyclonic storm systems in California and along the West Coast; and (4) orographic precipitation along the slopes of Mauna Loa volcano in Hawaii.

The results show the strong dependence of nuclear debris deposition upon synoptic parameters, with deposition rates changing slowly during precipitation in stable air, and as much as factors of over 100 in short-time periods during intense convective conditions. For large-scale uplift, Sr-90 concentrations were dependent upon descent experience below the clouds when precipitation was falling from relatively constant generating levels. For convective activity, Sr-90 concentrations were dependent upon the maximum height and intensity of convective cells and their location with respect to the tropopause, the jet stream, and regions of high dry air concentrations of nuclear debris of recent stratospheric origin. For Pacific cyclones, Sr-90 concentrations were dependent upon air mass trajectories, the intensity of the marine layer inversion, and concurrent largescale and convective activities. Work is in progress on initial studies of orographic precipitations.

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INDEX TO AUTHORS

(Figures indicate article number)

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